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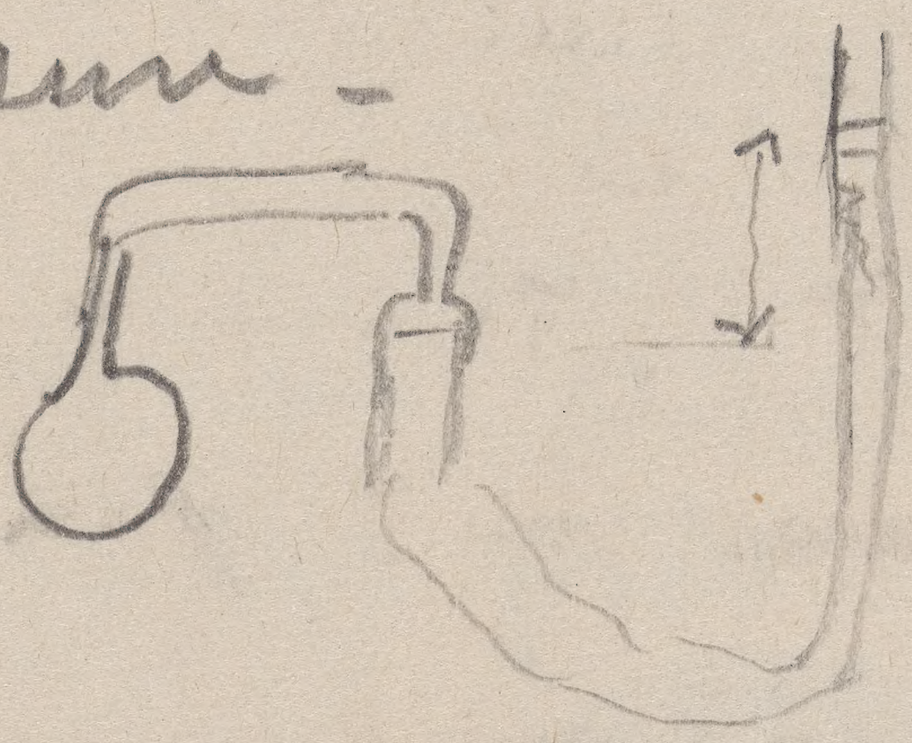
Heat a form of Energy - Thus proved
at by Count Rumford - Old theory
that heat was a fluid - Found
no diff in capacity for heat in ships
from brass - Hence old theory false -
Then used blunt tools -
Even to 1820 or 6 - men like
Carnot in France still held to old
theory - Dynamic theory not accepted
until 1850 -
Acts upon all bodies as known other
Illustrate production & action motion -

When heat passes from one body to another,
bodies observed did there is no change
in amt of heat - But one body will
hold full as long as much as other
does generally - Temp depends ...
on the body -

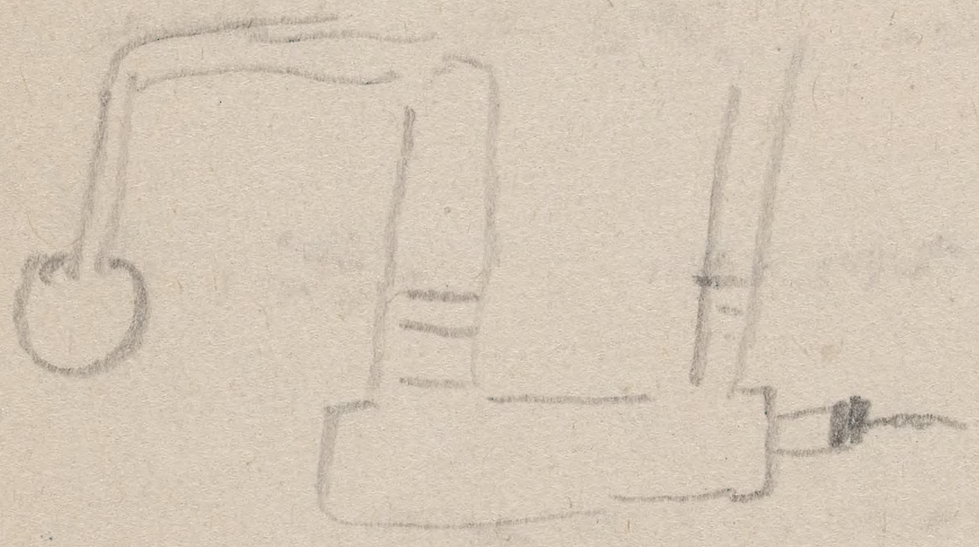
If two bodies are of the same temp as a
third body, then those two bodies would
have the same temps -

For accurate measurements we use the Air thermometer - Two forms - one in which air kept at constant vol. and temp determined by pressure -



Temp is proportional to pressure -

Other form is kept pressure constant and let vol. vary.



All gases have very nearly the same coeff. of expansion - Again expansion of gas is much greater than mercury - Hence the expansion of

MSS 837 B v. 3
RB NMAH

glass is a very small correction — and we can allow for this correction —

The cut thus. is used as a standard of reference —

Second Lecture —

Balfour Stewart on Heat —

Heat or Exc. But. by Thermom —

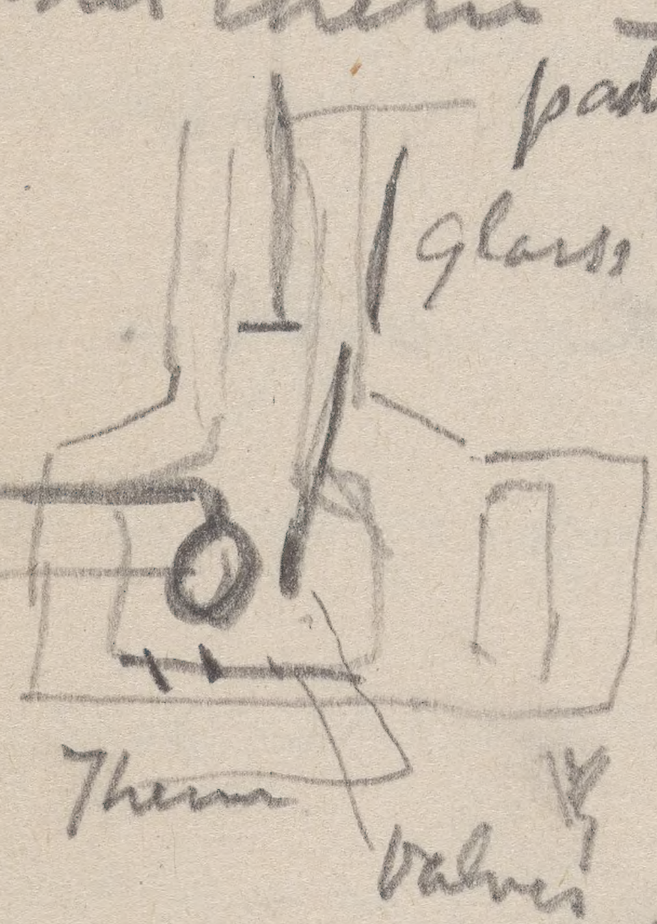
— suppose we raise unit of an — thus — from 0° to 100°, the pressure increases from 273 to 373, ∴ $\frac{100}{273}$ .760 m.m = 280.

hence at 100° will be 280 m.m.

due in height of column of mercury —

∴ 2.80 m.m for a degree. You can read perhaps to $\frac{1}{10}$ m.m. But. at same time you read Barom. for pressure of air wh. must be added to pressure of col. of mercury to find the pressure. Hence can only be used with absolute accuracy

When used for comparison, therm.
The bulb of air ther. is enclosed
in a water jacket - near it - as
close as possible are placed the
other therm



Stir until water at all heated
then remove heat - valves
close and time
water remains for abt 20
of constant temp -

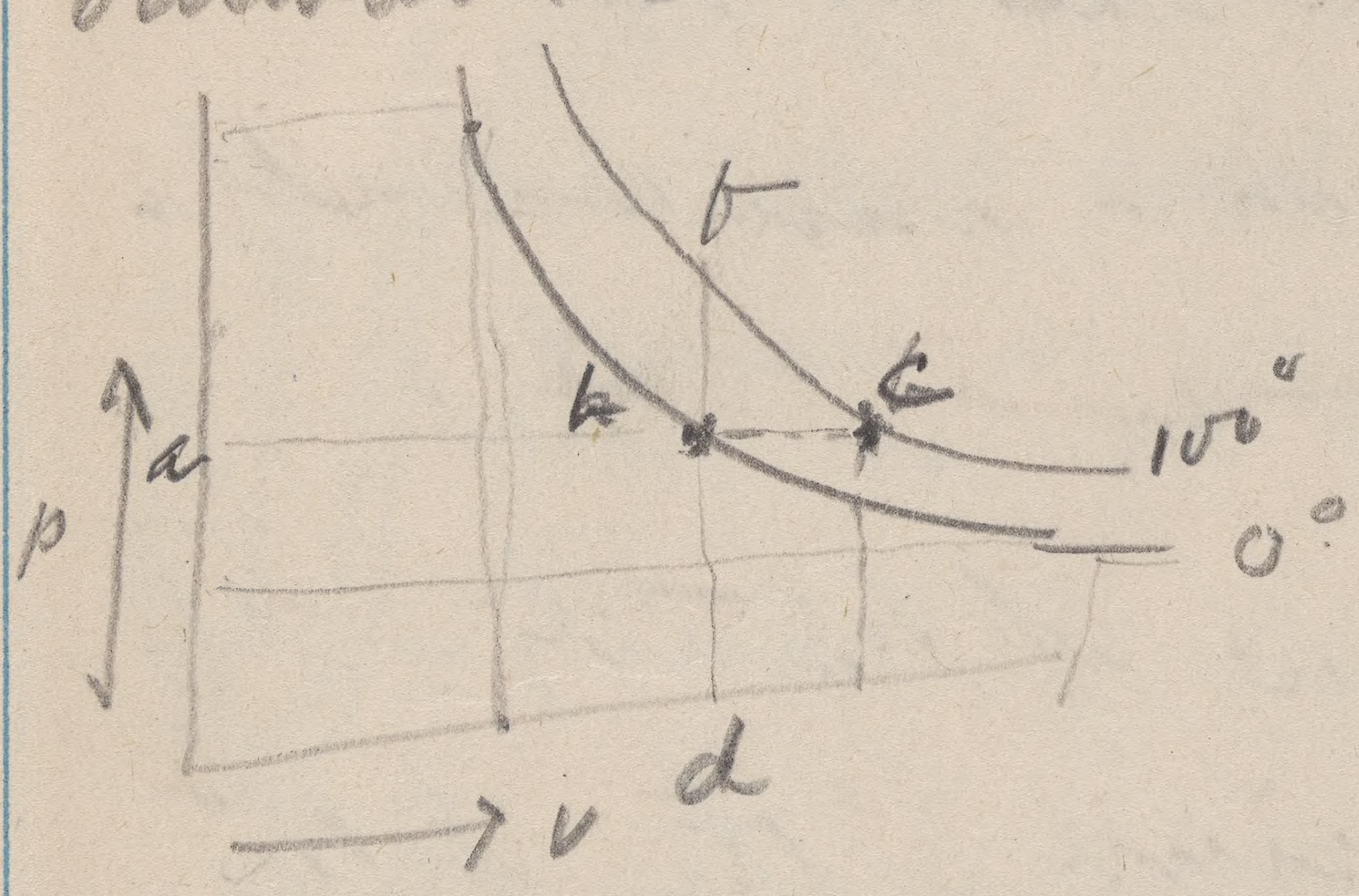
Regnault used, as before (1845) air two
diff. ways - Coeff. of ex. is not
same when pressure constant as since.

	R. Const -	V const
H.	.3661	.3667
Air	.3670	.3665
CO	.3669	.3667
CO_2	.3710	.3688
SO_2	.3903	.3845

DSI

The coeff of ex. when press is const-
is greater than when vol. is cons-
in all cases except H-

The diagram, pressures and
vols. on the ordinary coordin-
p. measured upward, vol-
ume d -



mass in that diag. curve const.
Equilat - hyp - line of equal temp-
or isothermal line.

coeff of ex = $\frac{bc}{ab}$, press const.

" " " = $\frac{bf}{bd}$; vol. const.

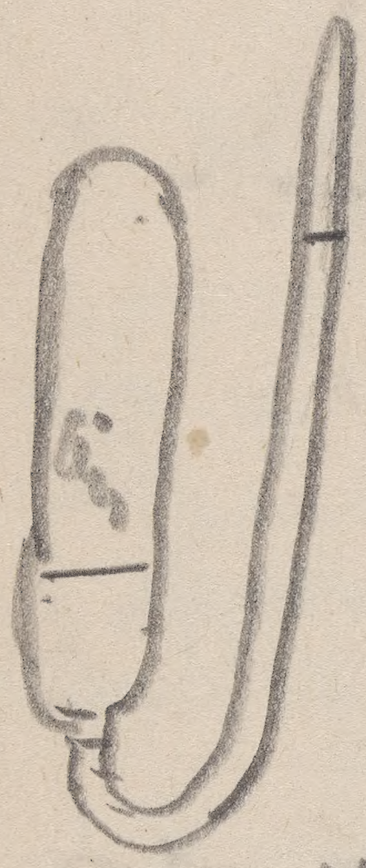
If these curves were equi. hyp

hyper, and of the gas obeyed Boyles
law. those coef should be equal-
But our tabs shows us that
gas doesn't. In case of H,
the curve is somewhat sloping-
in other cases somewhat flatter—

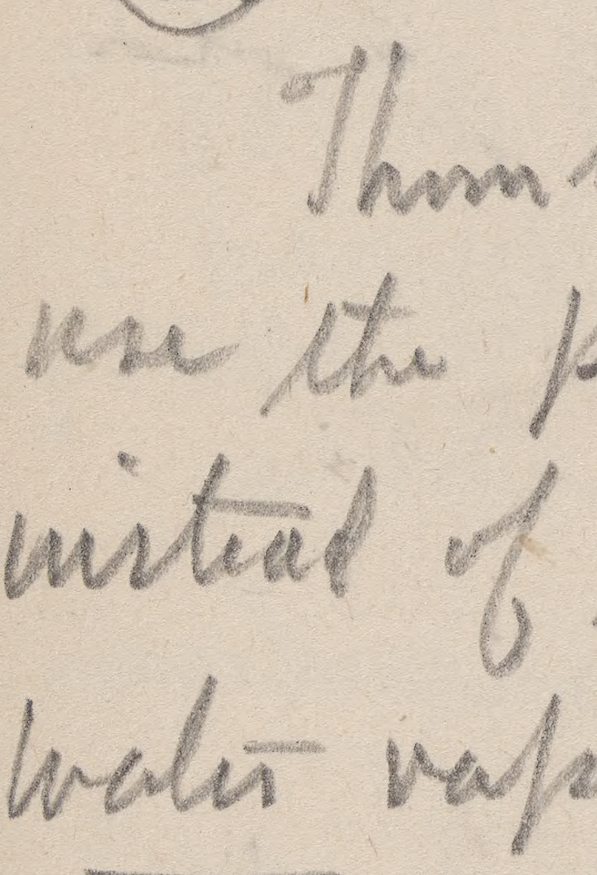
Also very few laws of Charles. etc
all gases have same coeff-
Result of this ex. is that
the higher degree of tenuity - the
less the pressure, the better
the gas obeys the laws—
Regnault observed that the
less the pressure, the nearer
the gas conformed with the
law of Boyle & Charles -

A diff. with Natter - in

smallness of height of col. of mercury
col. measures both - the might
use sulphuric acid instead
of mercury - Its vapor tension
is very small and may be neglected
it would give a larger measure -
Produced by
Am't sulph. acid. outside
pressure is gotten rid of -



Thus - proposed we should
use the pressures of saturated vapors
instead of expansion of substances -
water vapor. 734 99 .26 mm of mercury
760 at 100.
A change in col. of mercury.
of 20 mm. at boiling point
May serve for a
small range of temp -



should how to compare these Coeffs with those theirs —

we do Pressures & stress in a liquid.

Absolute system of measure force —
C.G.S. system — the get adeu
of force by muscular resistance
before matter by pendulum
to free & put in motion &
to invite. to measure to
keep at rest in motion by force
Having in this way what mass
of bodies we can measure
force. Change of momentum
is proportional to the impulse
or product of force & time
$m(v_1 - v_0) = Ft$.

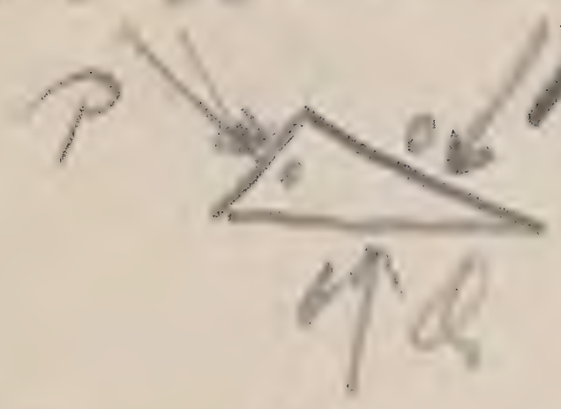
Unit of force acting on unit mass changes velocity by unit in unit of time.

Unit of force is known as the Dyne -

Unit of work - work is measured by product of force and distance at rects - Unit of work is work done by a force of one Dyne acting through a ~~distance~~ one centimetre unit of force unit of mass

Force of a gram is 980 times force of one dyne.

In fluids the pressures may be diff. in diff. directions — in legends the pressure must be same in all directions — pressures are normal & exert from one part & particles in a direction perpendicular to the surface — In a perfect fluid at any point the pressures are the same in all directions.



$\frac{Pa}{\rho g} \cdot \frac{Qb}{b} = \frac{Rc}{c} \therefore P = Q = R$

Most fluids satisfy the Conditions so a state of rest — Such that no fluid can exist in motion — Natural Conditions where pressures —

A substance like pitch, wh is brittle, will break, and at same time it will recover, with yield to small force if acting for time; hence a liquid- If a small force will deform the body it is a liquid- All solids even yield to very great force— Wax is more like a fluid- small shot sink into— Lead more like a solid— for pressures do not exceed limit of

There are three principal stresses of strain— This most general strain, has three different axes of strain— The simple kinds are longitudinal— in one direction— Surface— in two directions at

right angles — Stresses are deformations of the body — stress is the force acting upon the body.

The measure of work done is the force times the distance —

Fd = work. = $apd = Vp$

Gas $\frac{d}{V}$ $F = ap$ $ad = V$.

a = area of piston

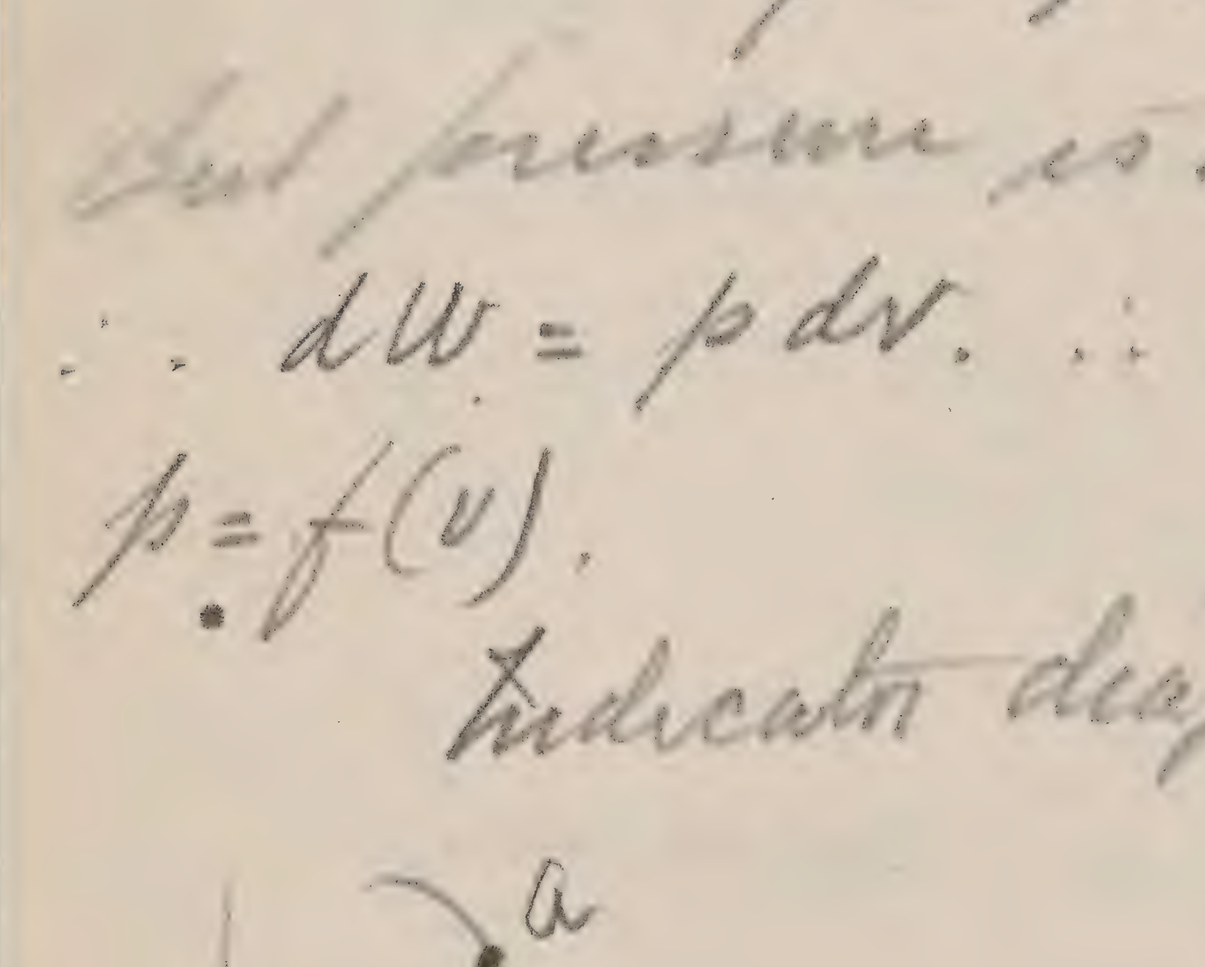
p = pressure of gas —

But pressure is not constant —

$\therefore dW = p\,dv$. $\therefore W = \int p\,dv$ —

$p = f(v)$.

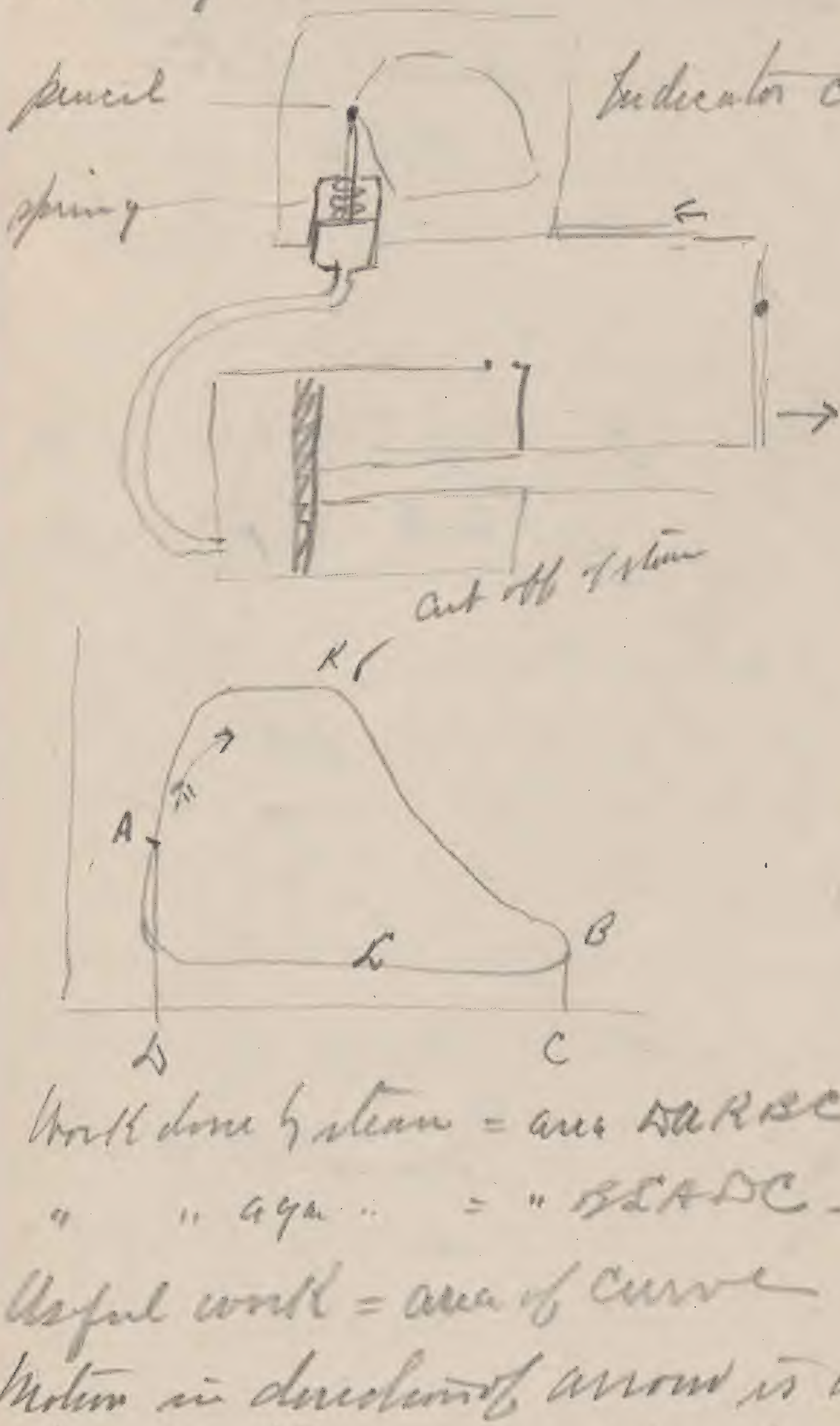
Indicator diagram



Area ABCd = the work done in passing along the curve

In passing from A to B gas does the work, from B to a, work is done

on the gas.



Work done by steam = area DARBC.

" " gas " = " BEADC.

Useful work = area of curve

Motion in direction of arrow is work done by steam, in opposite direction done by engine; a loss of work

Useful work is difference of two areas

Elasticity is the reciprocal of the force applied to the displacement in the direction of the induced.

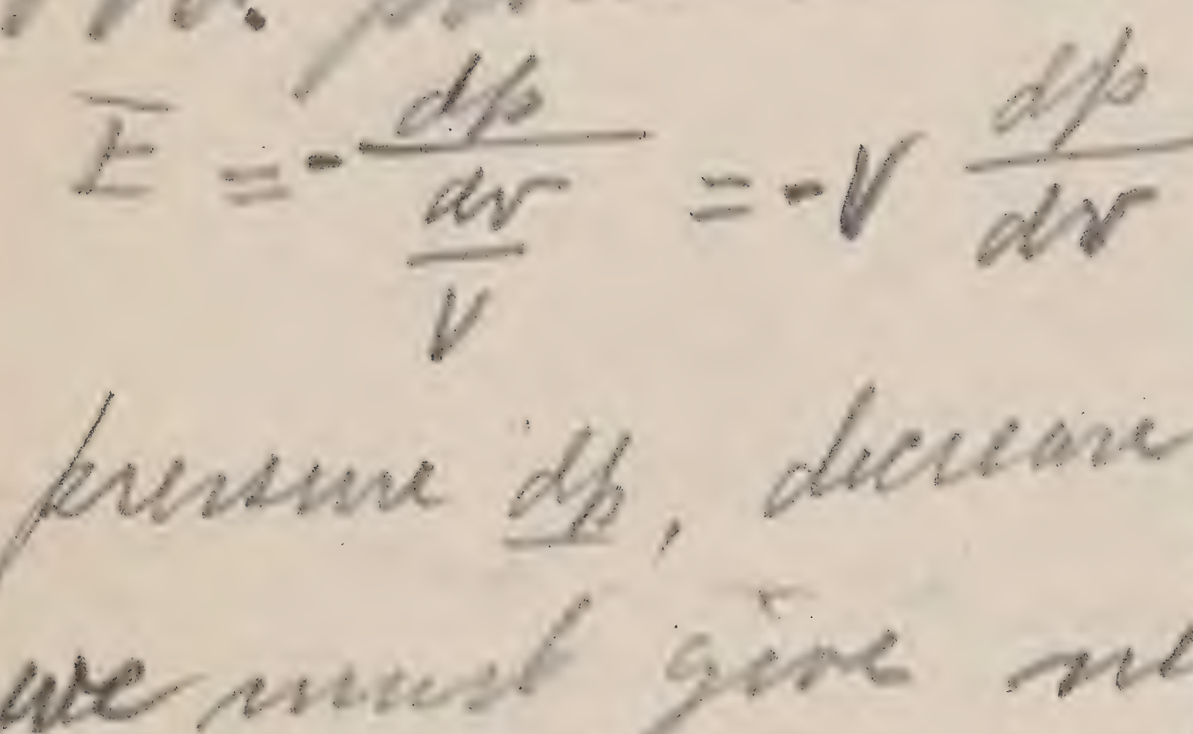
$$E = -\frac{df}{\frac{dv}{v}} = -v\frac{df}{dv}$$, where df pressure, decrease of work, dv, v, we must give negative signs

$12 = df$ $\therefore \frac{df}{dl} = \tan\theta$

$27 = dv$ $\therefore \frac{dv}{dl}$

$\therefore E = v \tan\theta_1 = \varepsilon\, dl$

in deep.



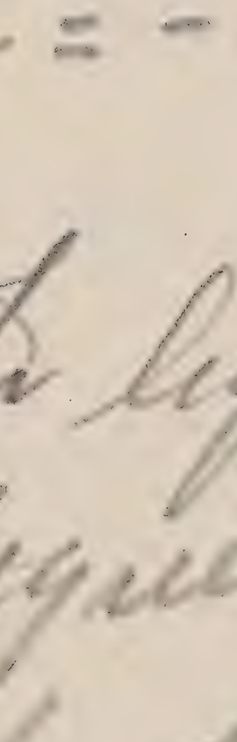
Elasticity must be given in terms of pressure.

In case of a perfect gas, the elasticity is numerically equal to the pressure. (At a constant temperature). The eq. of a perfect gas. $Vp = C$, differentiating $V dp + p dV = 0$

$$\frac{dV}{dp} = -\frac{V}{p}$$ substituting in eq.

$$E = -V\frac{dp}{dV} = -V\cdot -\frac{p}{V} = +p$$

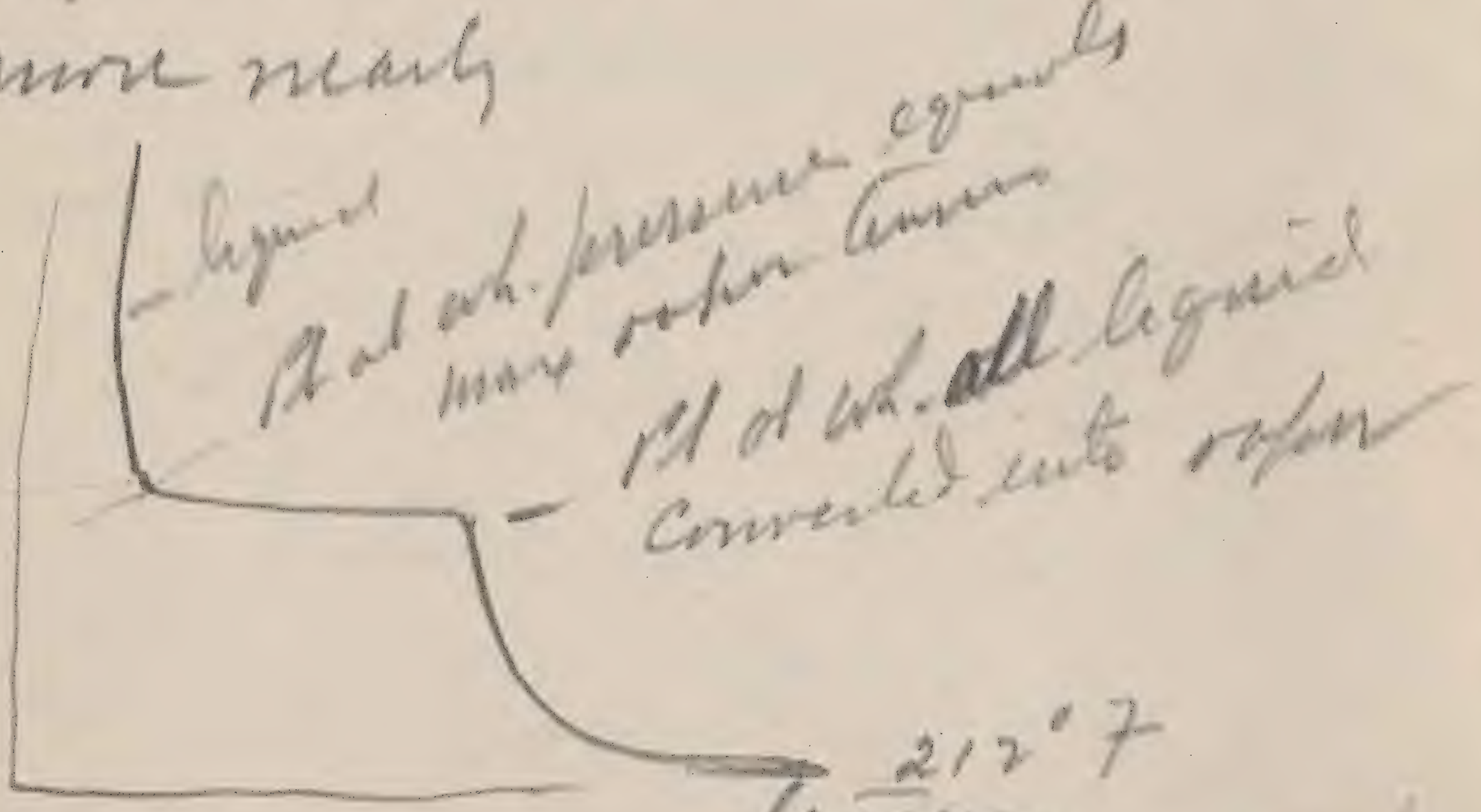
In liquids we meet a very high degree of incompressibility; hence the diagram becomes



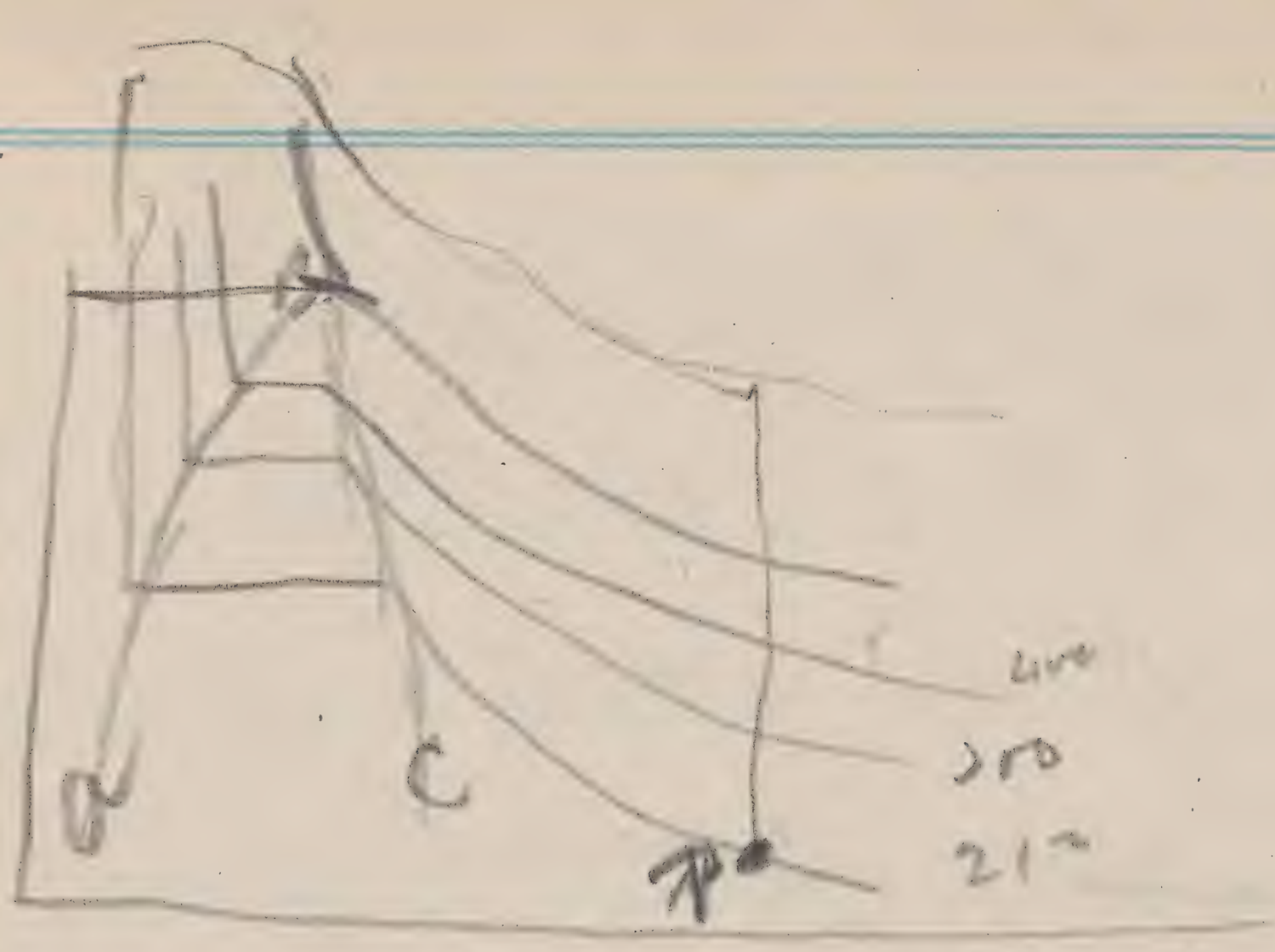
curve is very nearly a straight line - Elasticity is very great -

Saturated Vapors —

A vapor is in the saturated condition when it exists in contact with its liquid at such pressure & temperature that the slightest reduction of pressure will cause condensation. When a vapor is not in contact with its liquid it is said to be superheated



If water, under ~~atmospheric~~ pressure = 14.7 lbs per sq. in. abs. the point of ebullition or boiling point is called the 212° F



AB might be called the liquid line, BC, vapour line - These lines approach, and at B at why the meet the substance passes at one from liquid to gas - The corresponding pressure is the critical pressure, the temp the crit. temp, vol. crit. vol -

The critical region is a region of compressibility, the elasticity less, in case of gas, above crit. temperature

Every known gas has been condensed

Preiss statement page 117

Prof. J. Thomson, lives as

dotted, not as full -

Burning in boiling -

My heat legend above

the boiling point of water

by oil as in smooth tube; then

suddenly bursts into vapor - thus

showing the part of the curve

Adiabatic condition. No heat

is allowed to pass out or in part of

the body as heat - The heat

energy does not necessarily

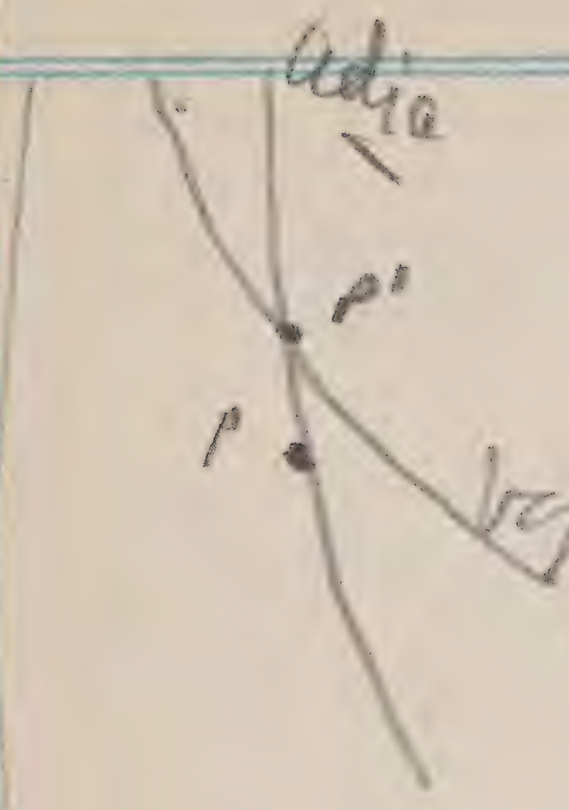
remain unchanged, it may

be transformed into work

The adiabatic line is steeper than the isothermal; prove & by experiment. Both these are curves & not straight lines. (137 page)

Suppose we are dealing with a sub. wh. expands when heated, & heated by adiabatic pressure. Take a body wh. contracts when heated & in this case a lowering of temp. —

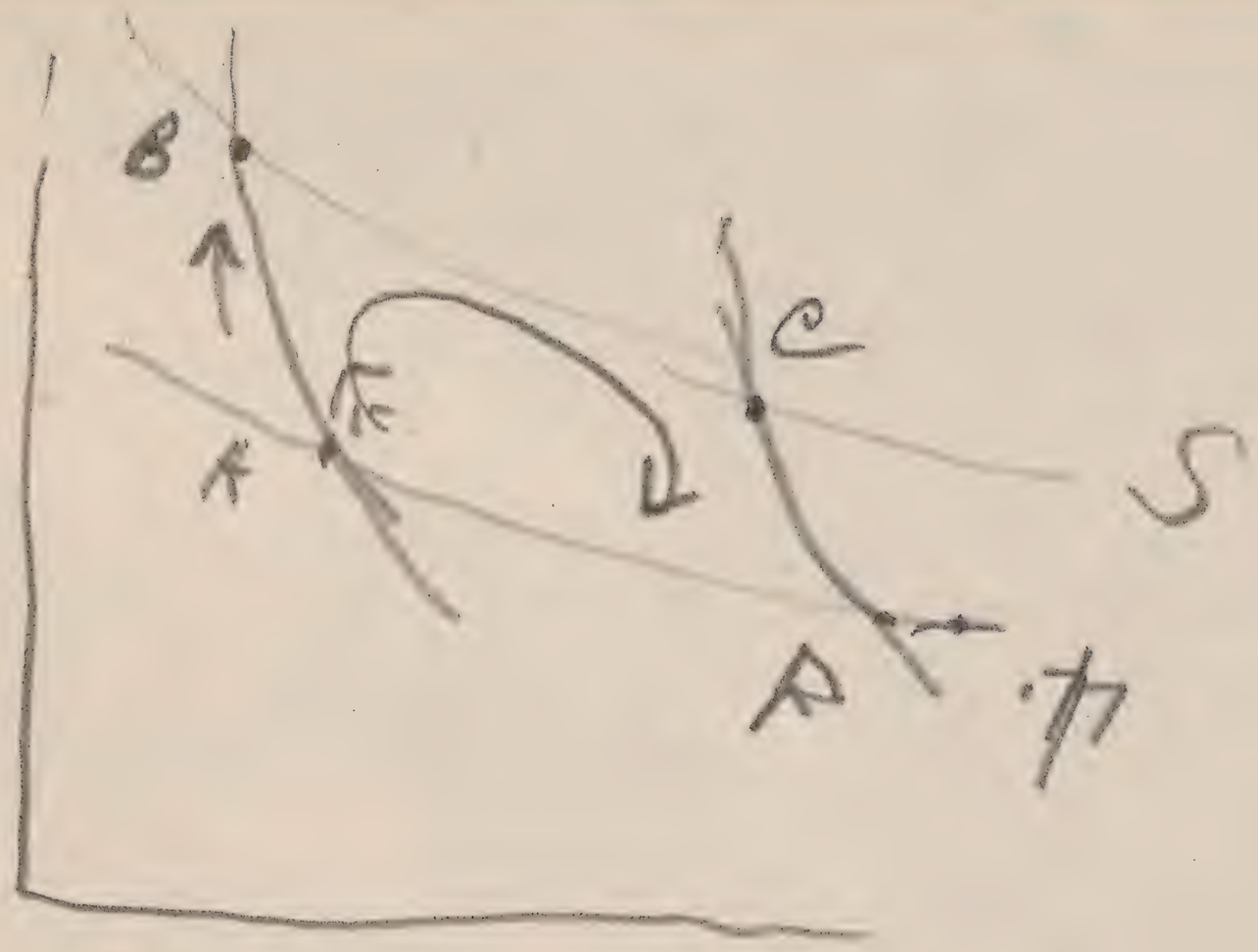
Relation between adiabatic and steam line, may be steeper than isothermal and less steep than water lines, or it may be reverse of this — For water & all substances which contract on heating



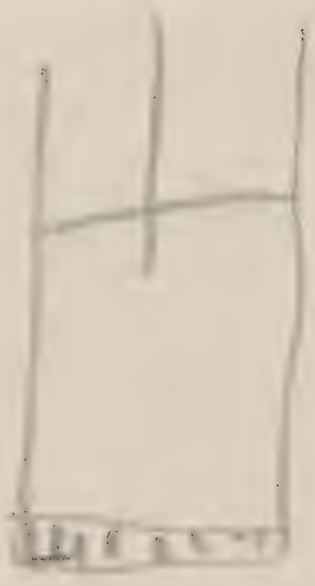
P. falls often and
liquid comes on
adiabatic condition
it reaches a point
where it could not
P further can it becomes
superheated. When release
effect from pile. The
effluence is selective.
At Condenser; effluence temperature
& temperature of surroundings
Decreased -

Cycle of Operations

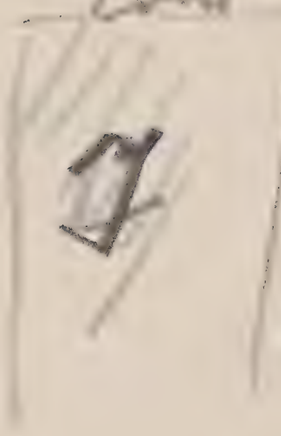
Cinch first introduced this
method - took a body. Sent
it through a series of
changes and finally brought
it back to same condition
as at beginning -



Start at A, continue at along an adiabatic line to B.



Shaded area represents heat energy converted into work.



Heat energy is converted into work.

Work done by body is area of closed curve — we have gotten work from the body — A quantity of heat is equivalent to a certain quantity of energy — Hence the amount of work is equivalent

b diff. of heat taken in and
heat given out -

$$W = H - h .$$

Efficiency of an engine is the
ratio of the whole amt. of heat
taken in to the work done -

$$\frac{W}{H} = \text{eff.}$$ This is a fraction
that is less than unity -

Before Carnot's ideal cycle
he knew, but would be known
upon the contrary, there no
called the reversing of the heat

Carnots proposition that the reversible
heat engine is the most efficient.
Prove it by having a more efficient
heat engine & reverse it

By hyp.

$$\frac{w}{H} < \frac{w'}{H} \quad \therefore w < w'$$

Let heat engine A take from hot
body for one cycle H & H' & let
other given up - But in reversed
& cold body

$$H = H - h \qquad H' = H' - h'$$

$$h > h'$$

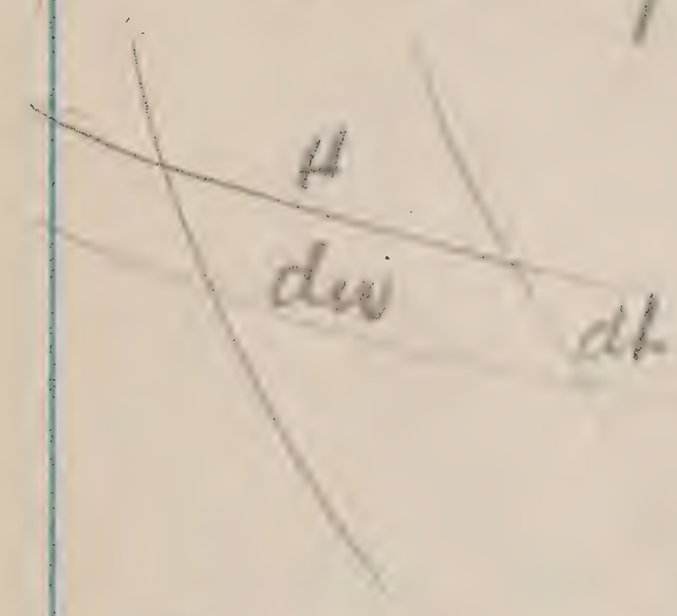
Hence the colder body loses more heat
than it gains - We on this getting
heat from cold body and converting
into useful work. Thus
2nd law of Thermodyn

It is impossible for any machine

to convey heat from one body to
one of higher temp—

A matter no difference what
substance we use as the
reversible engine. If you
take in some account of heat
and would believe same
temperatures, must have the
same efficiency
Carnot's function

$$\frac{dw}{H} = \phi(T dt.)$$

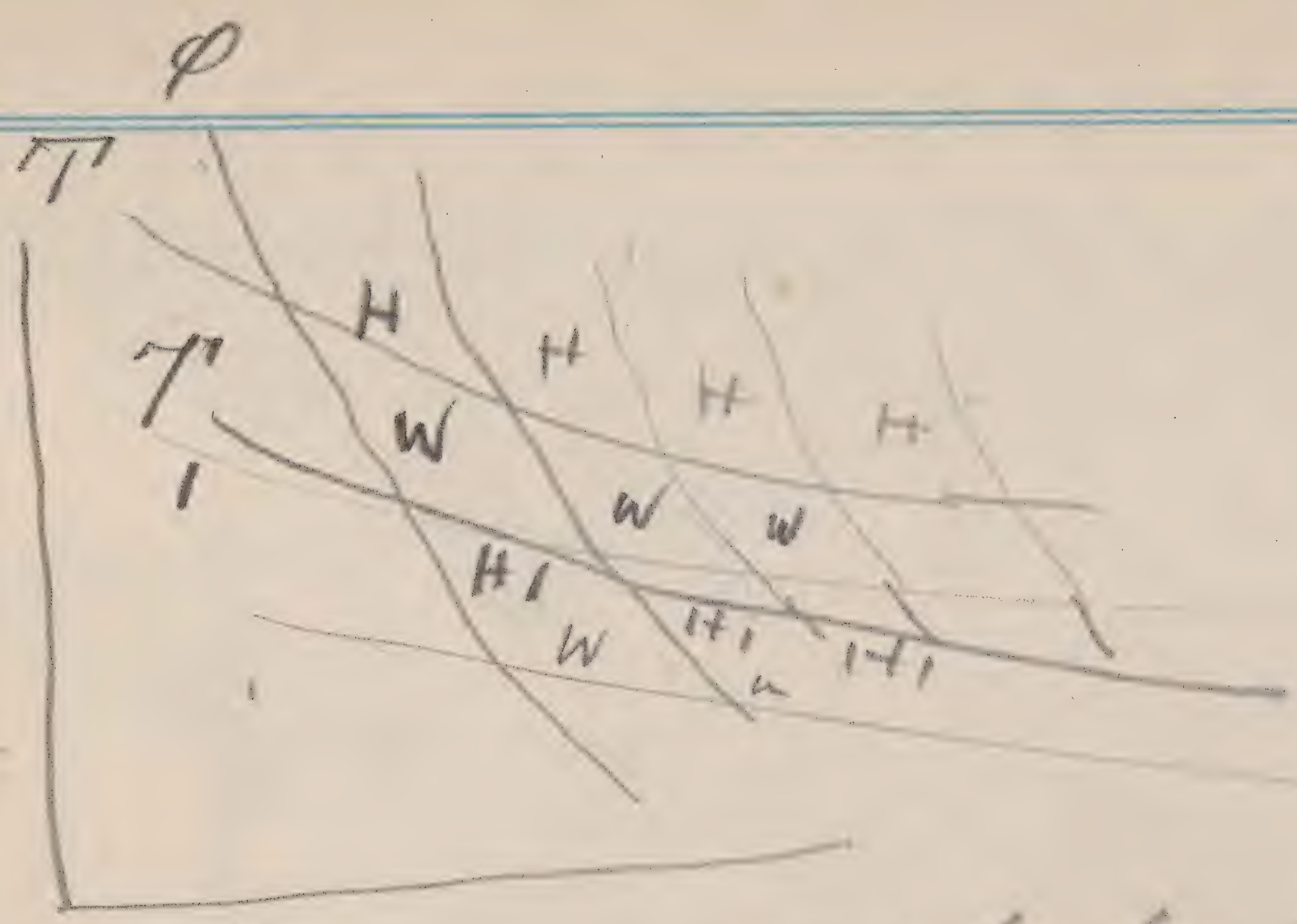


$$\frac{dw}{H} = \phi(T) dt. \quad \text{but as}$$

dw is perfect and dt. or.

$$\frac{1}{H} \cdot \frac{dw}{dt} = \phi(T)$$

$\phi(T)$ is Carnot's function — and
its form will depend upon the
way we measure temperature



The same amount of heat is absorbed when we pass along the isothermal from a to b, by reversible

Such a cycle independent of expanding substance, depends on relation between heat and work. In this method

$\frac{dw}{dq}$ = const. — But we have

as before $\frac{dw}{dq} = H\varphi(T)$

$\therefore$ Const $= H\varphi(T)$

$\therefore H\varphi(T) = H'\varphi(T') = H''\varphi(T'')$ — etc.

Efficiency of screw.

T	H
T_1	W
T_1	H'
T_{11}	H''

$$\frac{W'}{H'} = \frac{H\varphi(T-T')}{1+\varphi(T-T')}$$

$$= \frac{1+\varphi(T-T')}{H-H\varphi(T-T')} =$$

$$\frac{W'}{H} = \frac{T''-T'}{\frac{1}{\varphi(t-T)} - T'+T}$$

Making T'' = abs. 0, efficiency becomes unity.

$$1 = \frac{-T'}{\frac{1}{\varphi(T)} - T'+T}$$

$$T = -\frac{1}{\varphi(T)} \quad \therefore C = \frac{1}{T}$$

Rec

$$\text{Efficiency} = \frac{W}{H}$$

Measuring according to Thomson method, work measures as the temperature or $\frac{dU}{dt}$ a constant.

i.e. letting amount of work = w

$$\frac{dW}{dt} = H = C. \qquad Q = \frac{1}{\rho(T)} = \text{Constant}.$$

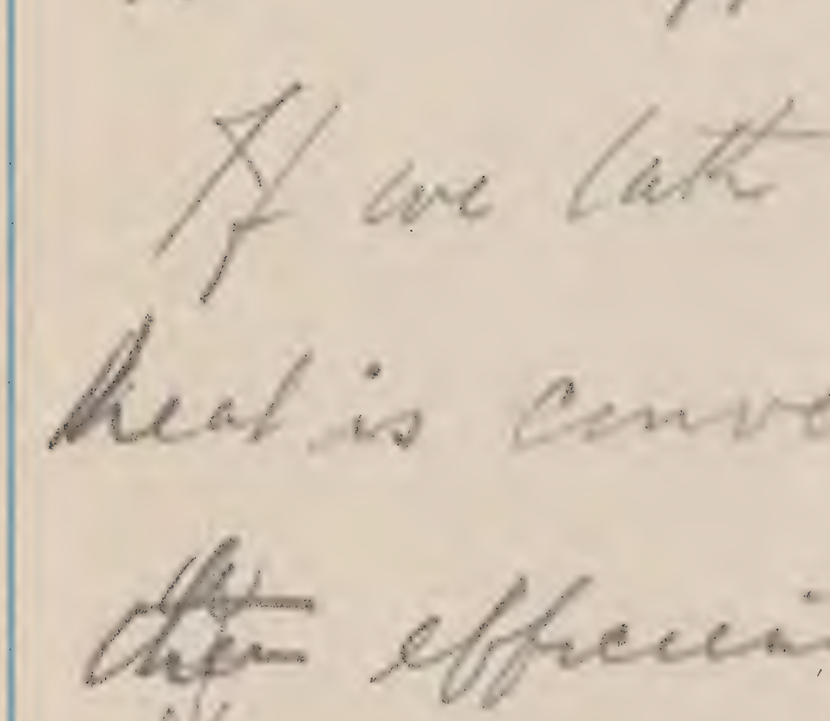
$$\frac{W}{H} = \frac{H C (T - T_1)}{H} = C(T - T_1)$$

If we let T_1 = 0 so that all heat is converted into work, i.e. $T_1 = 0$

then efficiency is unity

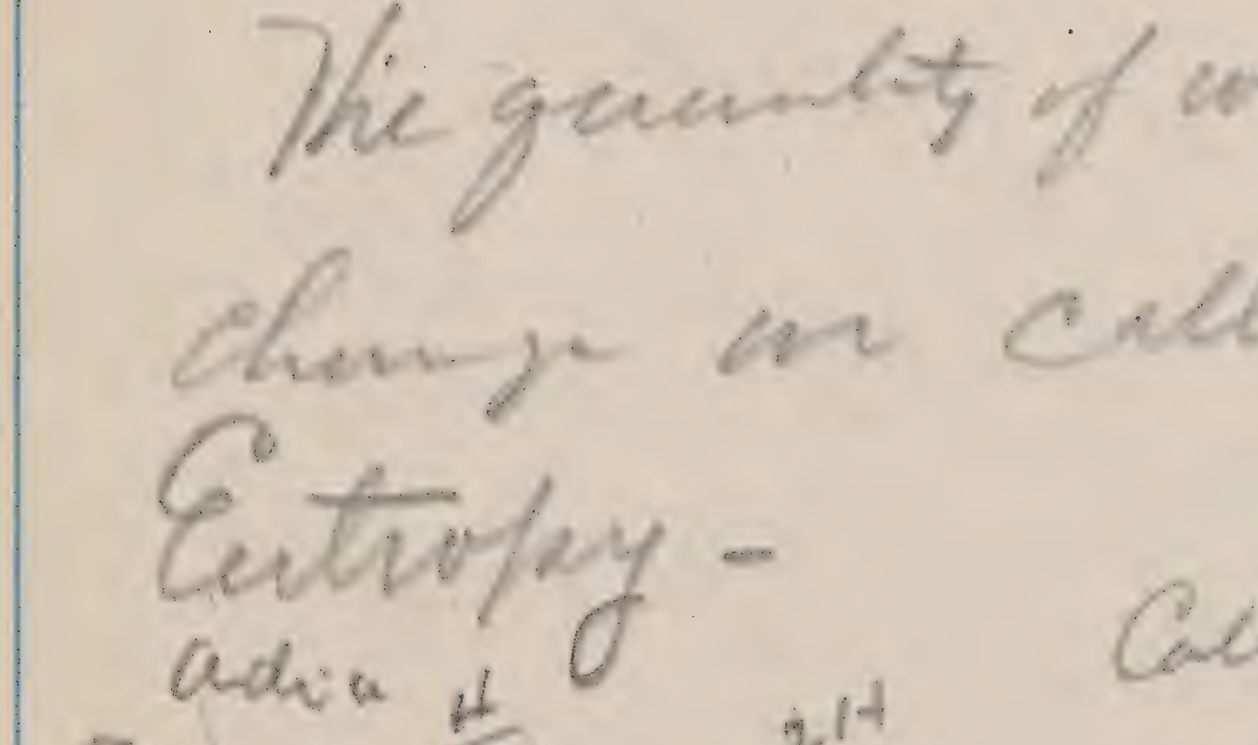
$$1 = CT \text{ or } C = \frac{1}{T}$$

How do we know that there can be no lower temp.? Suppose this is a Carnot cycle - According to hypothesis, no heat given out is passing along 0 line - If lower temp there



must be work done & engine
working between 0 and T_2
But no heat is taken in
by engine on 0 line, but work
is done. ∴ it must come from
the solid body, but this
contradicts 2nd Law of Thermodynamics
Therefore there can be no
lower degree of temperature than
that why marks the efficiency
of an engine against is unity

The quantity of wh, $\frac{p_2}{T}$ on the
change on call it
Entropy -
Call her 0, the
zero entropy
line adiabatics
lines may be
looked on



as absolute terms or terms of general entropy - Supply a thyrmal conception -

$\varphi_2 - \varphi_1$ = increase of entropy

$T(\varphi_2 - \varphi_1) = H_1$ heat taken in -

$\varphi_2 = \frac{H_2}{T}$ heat taken in absolute

$\varphi_1 = \frac{H_1}{T}$, by temperature

$T(\varphi_2 - \varphi_1) = H_2 - H_1 = H$ -

$T'(\varphi_2 - \varphi_1) = H'$ etc -

But $H - H' =$ work -

$(T - T')(\varphi_2 - \varphi_1) =$ work -

A generality of heat bases from one body to another at a lower temperature - what is obtained of heat by conversion -

T_1) H entering of 1st body changed by $= \frac{H}{T_1}$

T_2) Increase in entropy of $2^{nd} = \frac{H}{T_2}$

increase of system

$H\left(\frac{1}{T_2} - \frac{1}{T_1}\right)$, hence there is an increase in entropy of the system -

Free adiabatic Jaw -

Two thermodynamic relations

(page 166)

difference in heat is dh, and no entropy is diff

$$ABCD = AK \cdot Hk = OM \cdot \delta m$$
$$= aL \cdot al = OM \cdot \delta m$$

At a constant volume work, of a substance for a rise in temperature $dT = \left(\frac{dU}{dT}\right)_v$ for, where θ is the mean constant temperature —

dU is change in energy of substance corresponding to difference of entropy $-\left(\frac{d\psi}{d\phi}\right)_\theta d\phi = d\psi$, Latent heat at

$$-\left(\frac{dU}{d\theta}\right)_\phi \left(\frac{d\psi}{d\phi}\right)_\theta \delta\phi\,\delta\theta = \delta\psi\,\delta\theta$$

$$\therefore \left(\frac{dU}{d\theta}\right)_\phi = -\left(\frac{d\psi}{d\phi}\right)_\theta \qquad \text{(page 169)}$$

$$d\psi = \frac{dh}{\theta} \quad \Rightarrow \quad = -\frac{1}{\theta}\left(\frac{dh}{d\phi}\right)_\theta$$

Coeff. of expansion multiplied by temperature abs $= \theta$ latent heat of steam & vice versa

its pressure & density

If the pressure be measured by
units while the constants,
the quality of heat emitted.

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dM = mass in pressure &
vol of steam, one degree vol
constant. $= \left(\frac{dv}{dt}\right)_p dt$

dm = mass in vol. temp. const-
Entry mass
$= \left(\frac{dv}{dp}\right)_t dp$ —

$\therefore \left(\frac{dp}{dt}\right)_v = \left(\frac{dp}{dv}\right)_t \div \left(\frac{dv}{dt}\right)_p$ —

Latent heat of evaporation

Specific heat, constant pressure,

quantity of heat required to raise

unit mass one degree in temp.

K_v = specific heat constant vol.

$\varphi_1 - \varphi_2 = t$.

$\theta\left(\frac{\varphi_1 - \varphi_2}{\theta}\right)$ = amount of heat taken in

$\therefore \theta(\varphi_1 - \varphi_2) = Q$ for $\varphi_1 - \varphi_2 = 1$

$\frac{K_v}{a} = \frac{AM}{AN}$ $\quad \therefore K_v = \frac{a \cdot M}{AN} Q$.

$\frac{K_p}{\theta} = \frac{ak}{al}$ $\quad K_p = \frac{ak}{al} Q$.

$\frac{K_v}{K_p} = \frac{an}{AN} \cdot \frac{ak}{ak}$.

K_p = specific heat at const

pressure

Clusters

$E_\varphi = \frac{\alpha l}{\alpha n} V.$ clusters of constant energy

$E_\phi = \frac{\alpha k}{\alpha m} V.$ clusters of constant temperature.

$$\therefore \frac{E_\varphi}{E_\phi} = \frac{\alpha l . \alpha m}{\alpha n . \alpha k} = \frac{\alpha m}{\alpha l} \cdot \frac{\alpha k}{\alpha n}.$$

$$\therefore \frac{E_\varphi}{E_\phi} = \frac{K_p}{K_v}$$

$$\therefore K_t(E_\varphi - E_\phi) = E_\phi(K_p - K_v)$$

$$= T.V.K\overline{TM}^{n-1}$$

$$= T.V\left(\frac{d\theta}{d\theta}\right)_v^{n-1}$$

$$\alpha n = \left(\frac{dp}{d\theta}\right)_v$$

$$\alpha l . \alpha m = \alpha n . \alpha k = \text{ASCK}.$$

2nd Chapter —

BC = ab = adiabatic line

$$\frac{H}{\cancel{dp}} = \frac{AB.L}{V_2 - V_1} \quad H' = \frac{L' \Delta C}{V_2' - V_1'}$$

$$\text{Work} = \frac{AB + DC}{2} \cdot (P - Q) = AB(P - Q)$$

$$\frac{W}{H} = \frac{\delta - \delta'}{\delta} \times \frac{\cos. L}{V_2 - V_1} = dB(P - Q)$$

$$L = (V_2 - V_1)\,\delta \cdot \left(\frac{P - Q}{\delta - \delta'}\right)$$

And would thus result for

3d Thermodynamic

$$\left(\frac{dh}{d\theta}\right)_v = \left(\frac{dp}{dv}\right)_\theta$$

$$dp = \frac{dh}{S}$$

$$\frac{dp}{d\theta} = \frac{1}{S} \cdot \frac{dh}{dv}$$

$$\frac{dh}{dv} = \text{latent heat} = L$$

$L = S \frac{dp}{d\theta}$, latent heat in

terms of θ. $S = \theta$

$$L = (v_2 - v_1) S \frac{dp}{d\theta}$$

$$\frac{dp}{d\theta} = \frac{L}{S(v_2 - v_1)} = \frac{L}{S} \cdot \frac{1}{v_2 - v_1}$$

$\frac{L}{v_2 - v_1}$) = rate of increase

To determine the influence of pressure on melting point of ice

$$\left(\frac{dT}{dp}\right)_v = \frac{L}{T(V_2 - V_1)},$$

I determined on cards of work.

Given $\frac{L}{T(V_2 - V_1)}$ is essentially neg. for V_1 greater than V_2 ;

$\left(\frac{dT}{dp}\right)_v$ is neg. that is the pressure increases as temp decreases ∴ as ice melts at lower temperature + the point about .0175° C. for each atmosphere pressure -

pv = constant

&

$pv = c.$

We have now-

$$\frac{C_p}{C_v} = \frac{K_p}{K_v} = \gamma, \text{ constant for}$$

Most gases = 1.41

$$C_v = p. \quad \therefore \quad C_p = p\gamma$$

$$C_p - C_v = -v\left(\frac{dp}{dv}\right)_\theta$$

$$\therefore \frac{p\gamma\, dv}{dp} = -\frac{v}{dv}$$

$$\log p = \log c v^{-\gamma}$$

$$pv^\gamma = c$$

Same gas as vessel, allow it to expand
suddenly etc -

$P_1 \; V_1 \; T$ (1st state)

$P \; V \; \theta$ (Vessel open)

$P_2 \; V_1 \; T_1$ (vessel closed and at temp
of air.)

$$\frac{\theta}{T} = \frac{P}{P_2} \qquad \frac{P_1}{P_2} = \left(\frac{V}{v}\right)^{\gamma}$$

$$\frac{V}{v} = \frac{P_1}{P_2} \qquad \frac{P_1}{P} = \left(\frac{P_1}{P_2}\right)^{\gamma}$$

$$\log\left(\frac{P_1}{P}\right) = \gamma \log\left(\frac{P_1}{P_2}\right)$$

$$\gamma = \frac{\log P_1 - \log P}{\log P_1 - \log P_2}$$

$\frac{E_l}{E_k} = \frac{K_\rho}{K_v}$ this is General

The best method for the determination of the velocity of sound.

$V = \sqrt{E/d}$, velocity of any wave through elastic medium

$\text{Vel}^{\text{y}} = \sqrt{\frac{E_\rho}{a}} = \sqrt{\frac{k\sigma}{dL}}$, hence if we have velocity of sound, we can find σ

$$E_\sigma(K_\rho - K_v) = K_\sigma(E_\rho - E_\sigma)$$

$$= \pi V^2 \overline{aa}^2$$

$$= \pi V^2 \left(\frac{dL}{da}\right)^2_V$$

Apply the last case of a Rankeek gear. We have then

$\frac{k\sigma}{\sigma} = C$ -

We shall assume that Q or Thermody and Cp thro' are the same -

$$-\left(\frac{dp}{d\theta}\right)_v = \frac{L}{\theta} \cdot \frac{1}{J} \cdot \frac{dv}{dx} = C$$

Mechanical equivalent

$$Tv\left(\frac{dp}{d\theta}\right)_v = Tv\frac{L^2}{\theta v^2}$$

But $\varepsilon_0 = 1$. $\pi = \theta$.

$$\therefore K_p - K_v = \frac{Lv}{\theta} = C$$

$\therefore$ a constant difference in Thermodynamic heats -

$$\left(\frac{dw}{d\theta}\right)_p = \frac{w}{\theta} \quad \therefore \quad \frac{Lw}{\theta} = K_p\left(\frac{dw}{d\theta}\right)_p = C$$

Increase of vol. per unit increase of heat, mult. by pressure, - hence C = Amount of work done by unit mass of Gas in expanding one degree Perseus constant

= 53.21 ft. lbs. per degree Fah-

Therefore k_v

$$\gamma - 1 = \frac{c}{k_v} \quad \therefore \quad k_v = \frac{c}{\gamma - 1} = \frac{53.4}{0.440}$$

Gravitational constant
in mechanical units.

$$J = \frac{k_v}{J} =$$

Available Energy and Returns

Energy of a Body —

All energy of body is not available; however large it may be, there must be a certain amount of heat transferred to cold body and loss of work.

(Page 181)

$$(E_0 - E) - T(\rho_2 - \rho_1) = A = \text{Available}$$

Energy

We have proved that conductivity increases the velocity of the waves, & a result of conductivity diminishes amplitude very-

---

Called free expansion and Maxwell.

X

$$\left(\frac{dV}{d\theta}\right)_p = -\left(\frac{dq}{d\theta}\right)_\theta = -\frac{1}{\theta}\left(\frac{dh}{d\theta}\right)_\theta$$

$$dh = -\theta\left(\frac{dV}{d\theta}\right)_p d\theta = -\theta V\alpha\, d\theta.$$

$\alpha = \text{coeff. of expansion}$.

$$\text{but } \left(\frac{dV}{d\theta}\right)_p = V\alpha.$$

$$dh' = K_p\, d\theta.$$

$$dH = dh + dh' = K_p\, d\theta - \theta V\alpha\, d\theta$$

$$\text{but } -dp\,V = dH = K_p\, d\theta - \theta V\alpha\, d\theta$$

$$\therefore K_p\, d\theta = (\theta V\alpha - V)\, dp.$$

$$= -V(1-\theta\alpha)\, dp$$

To integrate this we may consider for mercury for example

V constant. (really is a function of the pressure), & coeff of expansion as constant, and consider θ as the rate at which constant, for it is in respect to pressure - K - specific heat also may be considered constant - In making these variables -

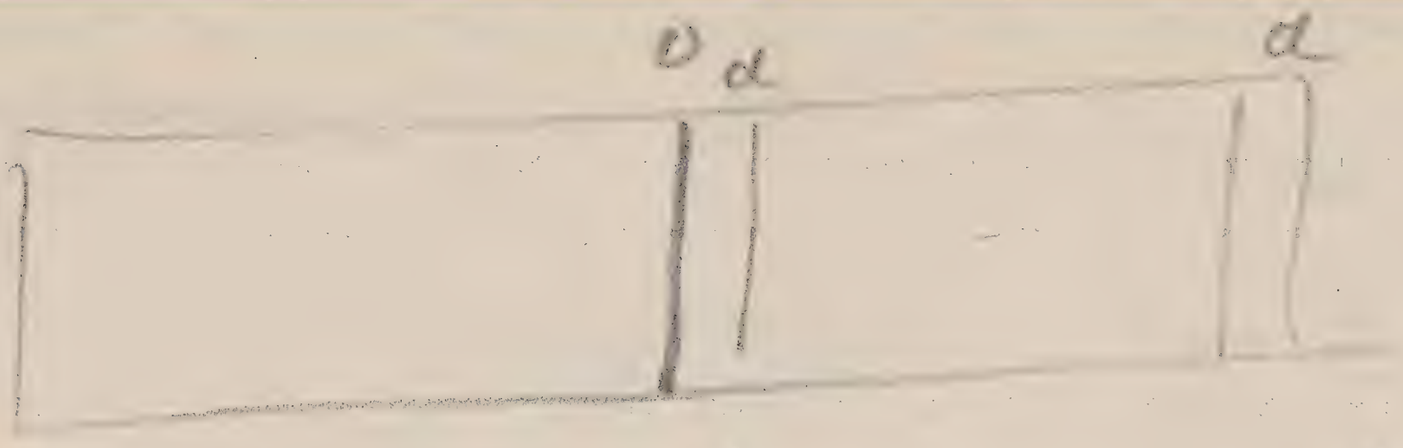
Isothermal

$\frac{1}{V}\frac{\partial V}{\partial P} = +\frac{1}{V}(1-\theta\alpha)(P-b)$

Now for gases, V as a function of P -

$PV = P_0V_0(1+\alpha_0 t)$ { Law of Charles + Gay Lussac

$V = \frac{P_0V_0}{P}(1+\alpha_0 t)$



$d = d$

$$\text{Coef}^{t}_{0} = \alpha_0 = \frac{d}{V_0}, \quad \alpha_t = \frac{d}{V}$$

$$\frac{\alpha_0}{\alpha} = \frac{V}{V_0} = \frac{1}{1+\alpha_0 t} = \frac{1+\alpha_0 t}{1}$$

$$\therefore \alpha = \frac{\alpha_0}{1+\alpha_0 t}$$

Making these substitutions we have

$$\frac{K}{P} d\theta = -\frac{k_0 V_0}{P}\left(1+\alpha_0 t\right)\left(1-\frac{\theta \alpha_0}{1+\alpha_0 t}\right) dp$$

$$= -\frac{k_0 V_0}{P}\left(1+\alpha_0 t - \theta\alpha_0\right) dp$$

Really k, θ, τ k_0 are unmeasurable, but by experiment we find k is constant Isothermally - Put $\theta = t$

$$K_p \tau = \tau k_0 V_0 \left(1+\alpha_0 t - \theta\alpha_0\right)\left(\log_e \frac{P_1}{P}\right)$$

to calculate θ, we have -

$$\theta = t + \frac{1}{\alpha_0} - \frac{K_p \tau}{\alpha_0 V_0 P_0} \cdot \left(\frac{1}{\log_{10} P - \log_{10} p}\right) \cdot \frac{.4342}{\log P - \log p}.$$

t = temp measured from freezing pt.

$\theta = t + \frac{1}{\alpha_0}$; Rowland formula

for θ, other terms are corrections

Gas	Coef Ex.	Ideal Effect	P-P=1at T=0°	$\frac{1}{\alpha_0}$	Corr
H	.36613	−0.035		273.13	−0.13
Air	.36706	+0.208		272.44	+0.70
CO_2	.37100	+1.103		269.35	+4.14

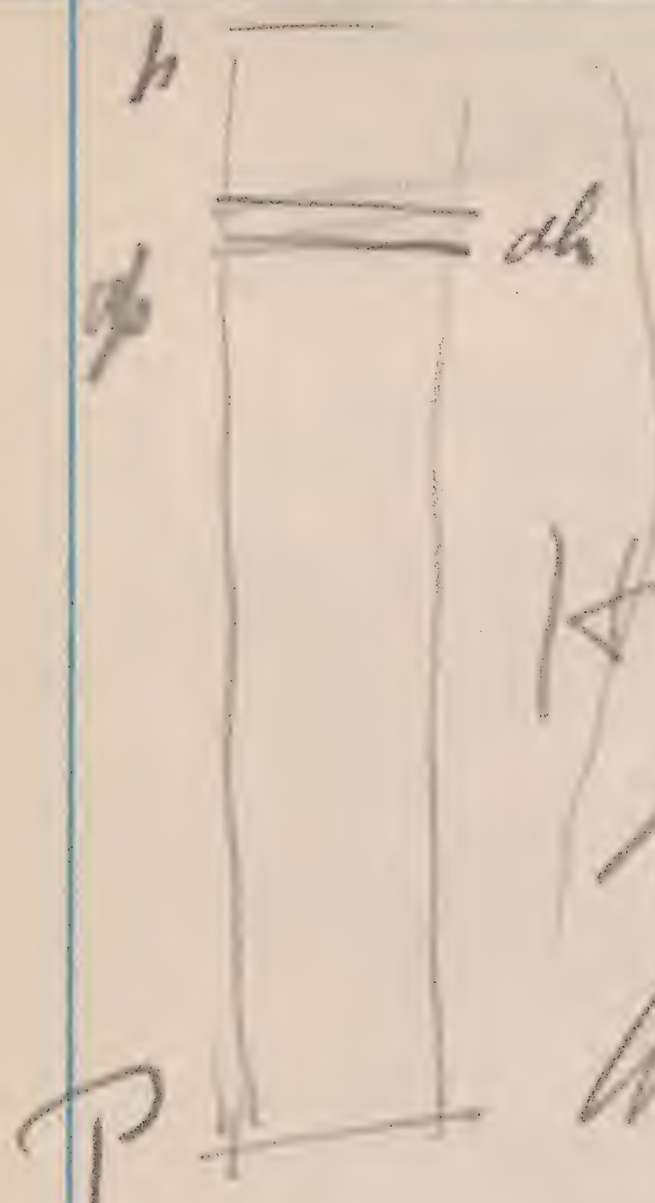
	θ_0
H	273.00
a	273.14
CO_2	273.9

Rowland's Mechanical Eqn. of Heat for Correction of Air Thermometer

Brunes & C.

These values apply to constant pressure air thermometer

— Barometer —



Let p & ρ be pressure & density at section

At el. of element dh at x from

$$\text{Mass} = \rho\, dh.$$

$$\text{Weight} = g\rho\, dh = -dp.$$

for as h increases p decreases

$$\frac{p}{\rho} = C = \frac{p_0}{\rho_0}$$

$$\rho = \frac{p}{C}$$

$$\rho = \frac{p_0}{p}\rho_0$$

$$-\int_P^p \frac{dp}{p} = \frac{g}{p_0 v_0}\int_0^H dh$$

Integrating

$$\log P - \log p = \frac{g}{p_0 v_0} H$$

$$H = \frac{p_0 v_0}{g} \cdot \log_\varepsilon \frac{P}{p} \quad \text{(Napierian log)}$$

$$= 2.3025 \frac{p_0 v_0}{g} \log \frac{P}{p}$$

— Waves —

Transference of motion, but not of bodies — Transfer of Energy

Radiation

Dulong and Petit's Law.

Newton's law of cooling was:

$$\frac{d\theta}{dt} = (\theta - \theta')/k,$$ velocity

of cooling proportional to difference of temperature.

Dulong & Petit

$\theta - \theta' = k$

k	$\theta = 0$	$\theta = 20$	40	60	80
240	10.69	12.40			
220	8.81	10.41			
200	7.40	8.58	10.11	11.64	13.40
180	6.10	7.04			
160	4.89	5.86			
140	3.88				
120	3.05	3.56	4.11	4.84	5.64
100	2.30				
80	1.74				
60		1.40	1.6	1.88	2.17

From this we see that Reaction
law of cooling is not true
either. Then —

We also see.

$$V(200) = 7.40 \cdot \frac{20}{(1.007)} \cdot \frac{7.40(1.161)^{20}}{7.40(1.16)^{40}}$$

$$V(400) = 240(1.0077)^{20} \cdot 7.40(1.0077)^{40}$$

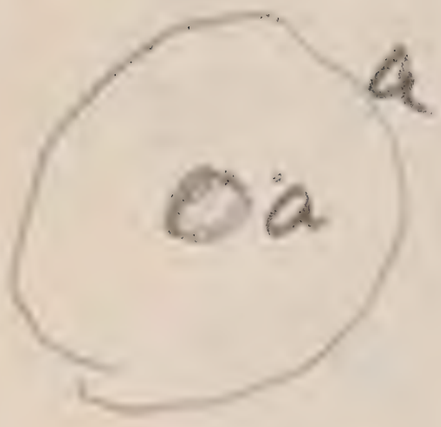
$$V_{200} = 7.4(1.0077)^{80}$$

$$V = \varphi(t)\, a^{80}$$

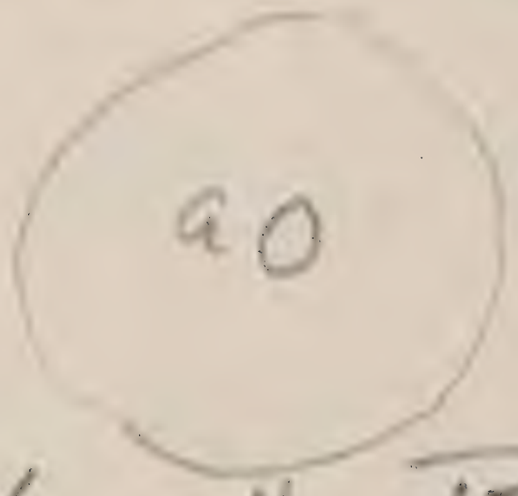
Fourth law of exchanges —
Let us have a body at temperature
L radiating
$a = 140$ A
$b = 80$ B
$C = 20$ C. —

If it is part of a couple at
same time. reckons as
much heat as it receives -

Velocity of earth = 0



V = 0



V = A - B.

V = B - C.

V = A - C = (A - B) + (B - C)

From our tables we

L = 60, D = 60

A - B = 2,17.

B - C = 1,40 If land as then ∴

2,17 + 1,40 = 3,57 - L = 120

D = 20

In table we find 3,56. This

is a confirmation of the work

The radial force depends only upon the body attitude it will be the $\gamma(\theta)$ - The force of the body to radiate or any like terms will be the same function of the sort - $\gamma(\theta+t)$. And the velocity of coming into the difference

$$\gamma(\theta+h) - \gamma(\theta) = \varphi(h)\alpha^\theta$$

Expand both sides of the eq -

$$\gamma(\theta) + \frac{d\gamma\theta}{d\theta}\cdot h + \frac{d^2\gamma\theta}{d\theta^2}\frac{h^2}{2} + \text{etc} - \gamma(\theta)$$

$$= A + Bh + Ch^2 + Dh^3$$

by undetermined coeffs.

$$h = 0 \qquad B = \frac{1}{\alpha^\theta}\frac{d\gamma\theta}{d\theta} \qquad \text{etc}$$

for a first approx. we neglect the higher terms

$$\beta \alpha^{\theta} d\theta = d\gamma$$

$$\therefore \gamma = \frac{\beta}{\log \alpha} \alpha^{\theta} + C$$

$\frac{\beta}{\log \alpha}$ = a const.

∴ Radius vector $= \gamma(\theta)$

$$\gamma(\theta) = m \alpha^{\theta} + K$$

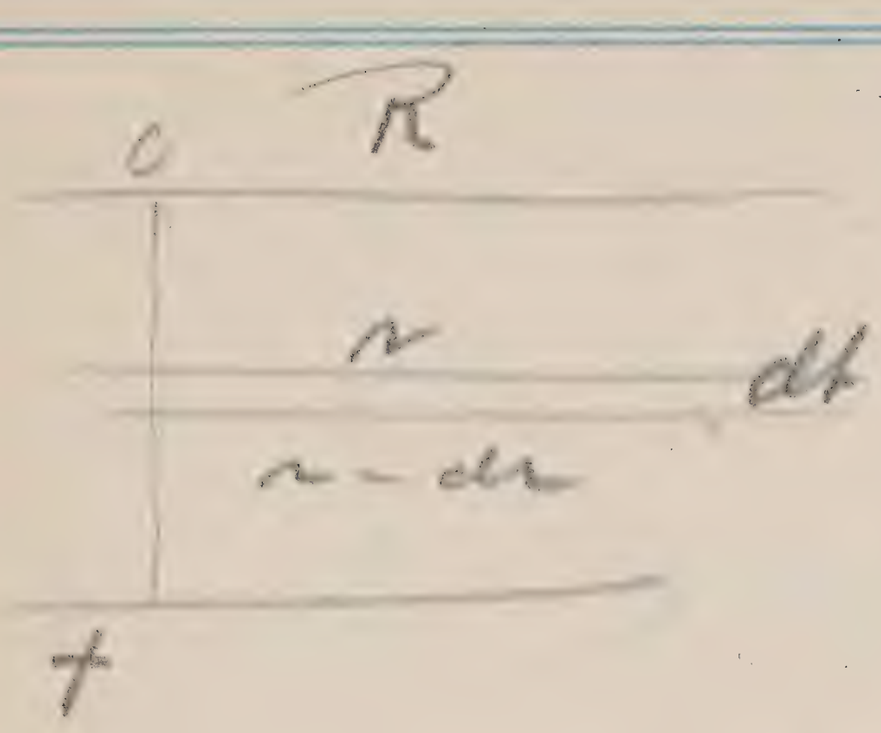
$$\therefore \gamma(\theta + t) = m \alpha^{\theta + t} + K$$

∴ Velocity of cooling

$$= m(\alpha^{\theta + t} - \alpha^{\theta})$$

$$= m \alpha^{\theta}(\alpha^{t} - 1)$$

body at temp $\theta + t$. on a radiating surrounding body θ. and receiving no radiations or cold from that body at temp θ.



$-\frac{dr}{r} = a\,dt$ for a short layer

we may assume that the radius

of the annulus of radiation t

to this resistance is proportional

to the thickness.

Integrate.

$$-\log \int_R^r \frac{dr}{r} = a \int_0^t dt.$$

$$\log R - \log r = at.$$

$$\log \frac{R}{r} = at$$

$$at = \frac{R}{r}$$

$$E =$$

The ordinary formula for

absorption — how have

used to calculate the ratio of

absorbtion of sun's rays by atmosphere
Langley "Selective absorption"

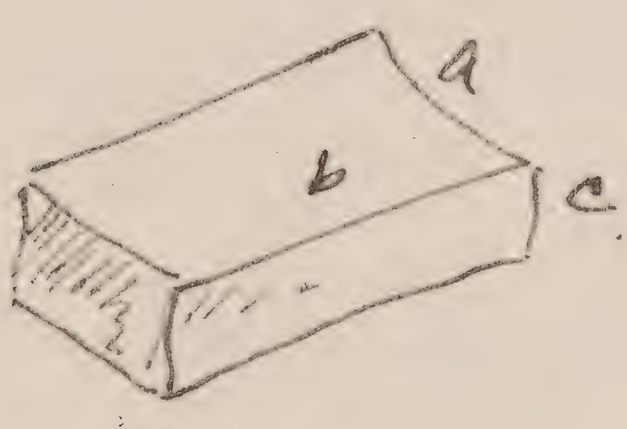
Conduction.

Energy derived from radiation
&c. is never certain. In radiation
during the passage there is
no heat.

Radiation from a hot body
is conducted with speed of
light.

Conduction the diffusion
of energy from one particle to
another. A slow process.
A direct action of one particle
upon the other.

Conductivity of a body.



steady flow, each surface kept at
constant temp.

$$H = abt.$$

water fall in temp. in
passage through the plate.

$$H = \frac{abt}{c}(S-T)$$

proportional and =, for it also
depends upon some constant
depending upon substance.

$$H = k\frac{abt}{c}(S-T)$$

$$k = \frac{Hc}{abt(S-T)}$$

k is the quantity of heat that
flows thro' a plate of unit cross
section, and thickness, in
unit time, with a unit

difference of temperature on
two surfaces.

$$k = \frac{H}{L T \theta}$$

$$k = \frac{M L}{t^2 T^3 \theta}$$

The mechanical expression
for conductivity.

Dimensions of k in thermal
units is M. Lbs. thus
in k.

$$k = \frac{m_L}{L T}$$

Again $k = L^3 \theta$

$$\therefore k = \frac{L^2}{T}$$

M = unit of Mass

L = " " Length.

θ = " " Temp.

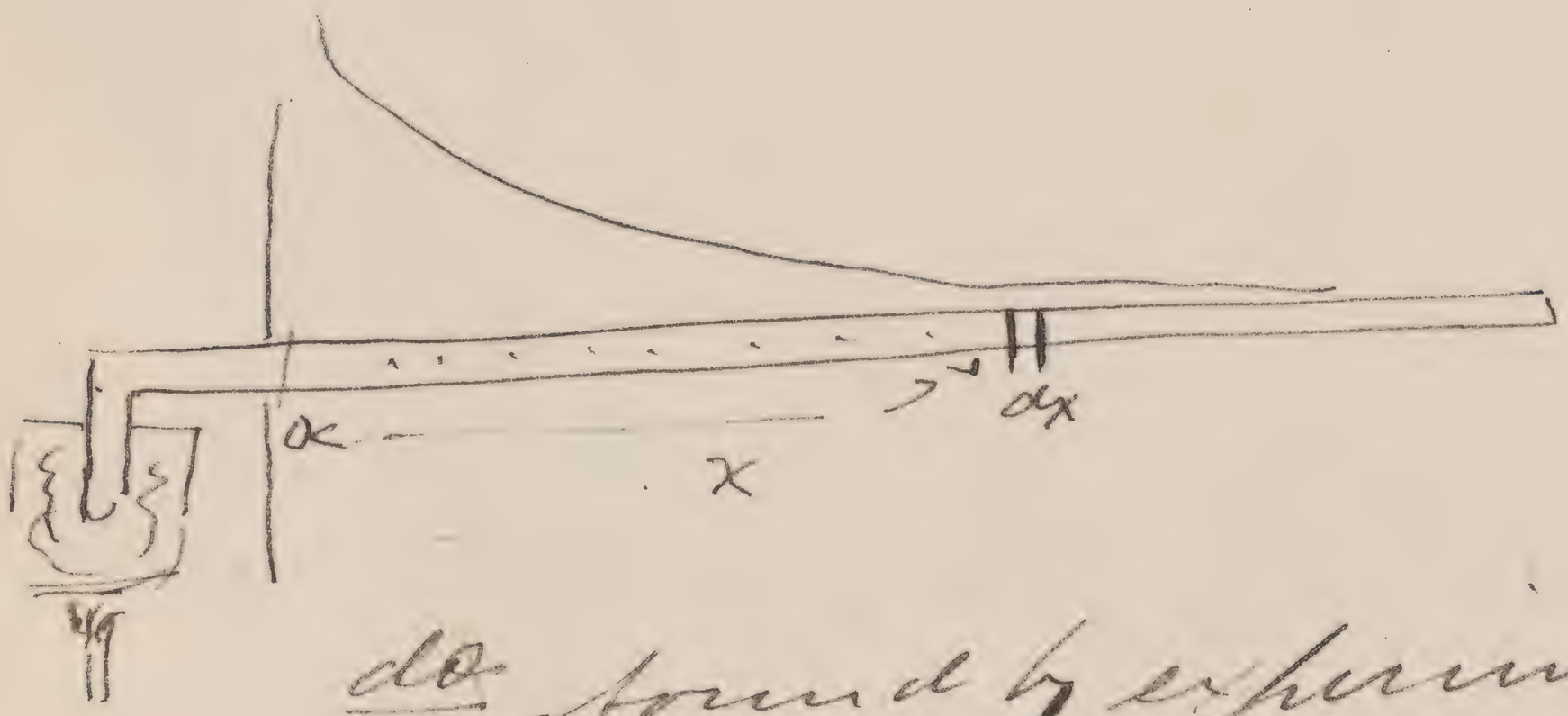
Mr Maxwell

Isothermal surfaces

Lines of flow always at right angles to these surfaces.

Tube of flow — The amount of heat wh. enters any section must be the same, if there be steady flow. If conductivity be the same at every point. More rapid change of temperature, near the hot body —

Study all Maxwell



$\frac{d\theta}{dx}$ = found by experiment.

a = area section of bar.

$$-I = \frac{abkt}{c}\left(\theta - \theta_1\right)$$

$$\frac{d\theta}{dx} = \frac{\theta - \theta_1}{c}$$

$$\therefore H = k a \frac{d\theta}{dx}$$

Let bar stand until constant temperature. Loss of heat = heat which passes through bar.

And H = amt of heat radiated by bar from x to end = θ

find this make another experiment

Find cooling curve for a

similar bar.

From this we find

$$\frac{d\theta}{dt}$$

$$\text{Mass} = A\,d\,dx.$$

$A\,d\,\delta\,s\,dx$ = quantity of heat that flows in or out per change of temp. of 1°.

Rapidity change of temp $d\theta$.

$$d\theta\,H = A\,\delta\,s\,dx\,d\theta.$$

Rate at which heat escapes from bar

$$\frac{d\theta\,H}{dt} = A\,\delta\,s\,\frac{dx\,d\theta}{dt}.$$

in unit time. The amount

integrate this for length of

for $\int_x^L a\,dx \frac{d\theta}{dt}\,dx = k\,A\,\frac{d\theta}{dx}$.

$$k = \frac{L^2}{t}$$

$$\underline{kt = \alpha^2}$$

Conductivity of bodies is different at different temperatures. Such results have been obtained by Forbes' experiment. The bars the temperature, the greater the conductivity.

Same order of conductors
of heat as for electricity.

The progress of wave
of temp. depends not only
upon conductivity but
also upon specific heat
of substance. Must
therefore deal with the
case of steady flow of
definite conductivity

Diffusion — Ratio heats of diffusion of mass. Energy and of momentum.

In case of diffusion of liquids. it makes no difference whether heavier or lighter above — perfect mixture can take place without diffusion — stirring presents larger surface and hastens mixture. All liquids will not diffuse ex oil & water; all gases diffuse perfectly.

We have investigated the laws of diffusion very carefully -

Coef. of diffusion is of same form as that of conductivity

$$d = k\frac{t}{c}$$

$$K = \frac{cd}{t} = \frac{l^2}{t}$$

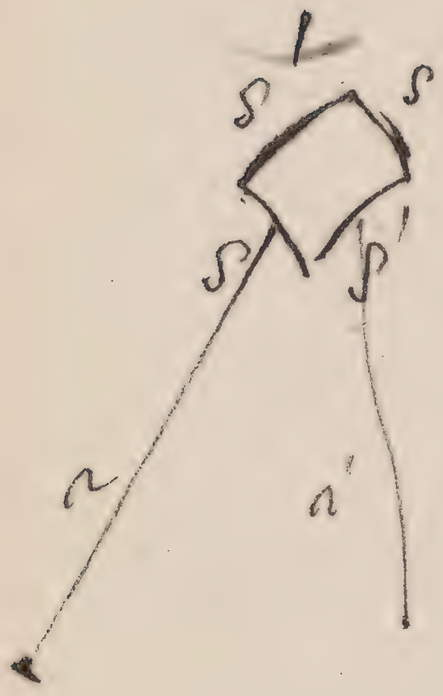
On molecular motion without movement of mass.

Corollary

For since a ray has no part the ray was a function of p, v, t, q. any two of wh. determine all the other three. We have had some exceptions as rays of glass, (must know its part history).

We now come to cases in which ray depends upon surface. Certain part of ray & a liquid depends upon the surface - This is not found

in a mixture of liquids
that hopefully diffuse into
each other.



and n' nodes of
curvature of this
element of surface
Face adjacent to Junk
this element out is
$b_{22'}$
that's pressed force Lindsay
to keep in place
resultant force FS
is exerted along
the tangent plane

2 Tsin α is force binding

to hold element in.

$$\text{Nc}\,\alpha = \sin\alpha = \frac{S'}{2r'}$$

∴ force on two edges s' is

$$\frac{Ts s'}{r'}$$

and on edges s'

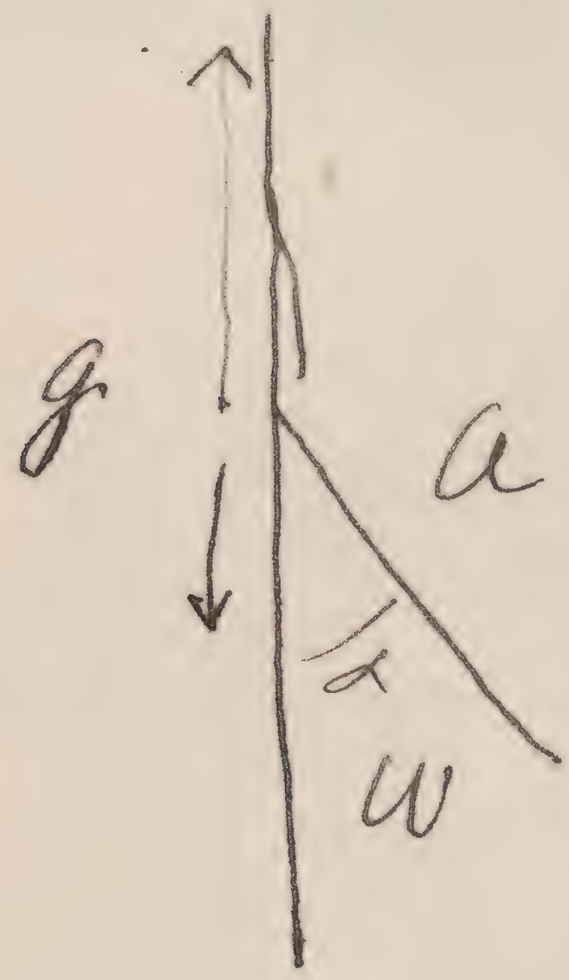
$$\frac{Ts s'}{r}$$

And therefore we have

$$p s s' = T s s' \left(\frac{1}{r} + \frac{1}{r'}\right)$$

$$p = T\left(\frac{1}{r} + \frac{1}{r'}\right)$$

Equilib. of liquid against a solid wall.



Tension below $q.a = T_I$

" $q.w = T_{II}$

" $qw.a = T_{III}$

$\therefore T_I = T_2 + T_3 \cos\alpha.$

$$\cos\alpha = \frac{T_I - T_2}{T_3} = \frac{T_I - T_2}{T_3}$$

If $T_I - T_2 > T_3$, an upward

case.

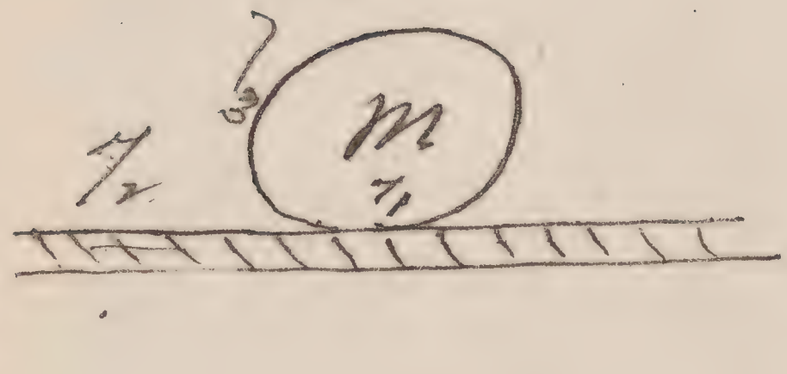
In case of mercury we

have a negative contact

angle, this shows

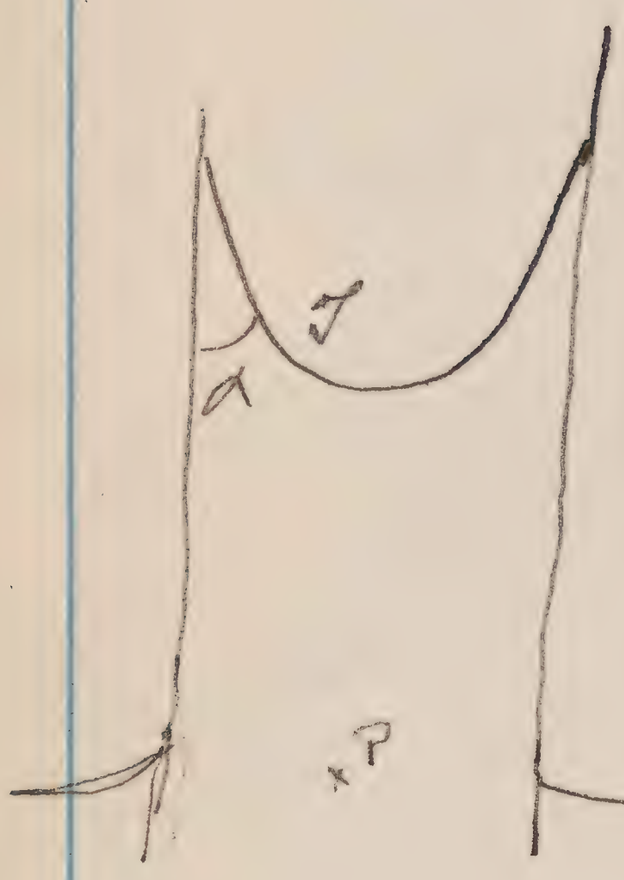
$T_2 > T_I$

Disp of mercury
in glass in air.



g.

Liquid in tube



The pressure at
points P & P' on same
level must be
equal for liquid to
be in equilib.

$\pi r^2 l$ = downward pressure

Tension due to surface acting
upward

$T \cos\alpha \cdot 2\pi r$.

Wt. of col. of liquid

$\pi r^2 h S_g$

the total downward pressure

at b' is

$$\pi r^2 l g - T \cos\alpha . 2\pi r + \pi r^2 h \delta g .$$

And total downward force

in equal surface tubes

of tube at b.

$$l \pi r^2 + h \delta g \pi r^2 .$$

And these two expressions

must be equal; whence

we get

$$h = \frac{T \cos\alpha}{(\delta - \sigma) g} \cdot \frac{2}{r}$$

The tension is only

capable of producing a

contains weight of the liquid
hence in a large tube
the surface becomes flattened.

8.	13. 35
13.	13. 10
14.	12. 82
20	11. 62
28	9. 73

Müller, ml 1. Jahr 346

Vicinity -

The law of Charles that all gases have the same coeff. of expansion, shows that the laws of gases are simpler than those of liquids or solids. Same result is also shown by the study of gases. Induces a great simplicity in gases. and that gases are made up of
constant particles. We know that under various pressures the vibrations of gases remains the same, giving the same refrangible bands in the spectrum. These separate particles of a gas are alike, shown by chemical reasons, and also by physical. The diffusibilities

of gases through a porous plug
are as the square roots of the
densities of the gases. Can these
separate a mixture of gases
of different densities, and as
if the weights of molecules of a
gas were different the density
after diffusion will be different from before. Such is
not the result.

It knows that light is
emitted, and if we heat a
gas, the energy of the light is
increased, as we increase the
energy of the gas. Hence we
have the elements of the
kinetic theory. That the particles
of the gas are in motion.

Essay on Atoms

by Wm Clifford

the molecules of gravity of a mass of gas is the same as that of a plane which has the same number of particles per square unit of area, and this is the motion of the mass as a whole -

We must also think of the motion of the molecule itself. We can't think of the energy of the molecules as potential energy. We must think of the particles as far apart that the resulting force due to attraction can be neglected - and the energy is due to the motion of the molecule.

The molecule is no doubt a very complex physical structure. Known by the spectrum

the minimum number of lines
in the spectrum of any vapor for
example.

The molecules of a gas are
all alike, and have energy as
a whole and internal energy.

An ordinary condition the
molecule on the free path is
free from attractions etc. Violations
of Boyle's law; since
the pressure on a vessel when the
gas has twice the density, etc.
And we reach the same result
by the kinetic theory in the
supposition that the particles are
free from attractions. But as
we measure pressure greatly we
find departure from Boyle's
law! and in some way if

we take account of size of particle and the attractions we would obtain similar result by kinetic theory.

We shall think of these molecules as perfectly elastic, for if not the pressure on a vessel would decrease on standing. but it does not.

The average of the kinetic energy of the particles remains unchanged. but the distribution of velocities may change - The law of distribution of velocities is the probability curve.

If we mix gases of different densities, then the heavy particles give up some of their velocity to the lighter; thus velocity decreases while that of light molecules increases. Let us have

$$\tfrac{1}{2} m V^2 = \tfrac{1}{2} m v^2$$

this law was determined by Maxwell -

Maxwell has determined that the force between two molecules varies inversely as the fifth power of the distance

$$P = \frac{k}{r^5}$$

the sum therefore as the distance has any small length the force of repulsion becomes enormous -

the have

$$p = \tfrac{1}{3} \rho \overline{v^2}$$

$$= \tfrac{2}{3} n \cdot \tfrac{1}{2} m \overline{v^2}$$

$$= \tfrac{1}{3} \delta \overline{v^2}$$

when the average kinetic energy

of the atoms of gas are the

same then the gases have the

same temperature.

$$p = \tfrac{1}{3} m' n' \overline{v'^2}$$

$$= \tfrac{1}{3} m n \overline{v^2}$$

of the pressures are the same: if

again the temperatures are the same

then $\tfrac{1}{2} m \overline{v^2} = \tfrac{1}{2} m' \overline{v'^2}$

Avogadro's law

$\therefore n = n'$

If therefore we have two gases at

same pressure and temperature

will have same number of

molecules in unit volume

Law of Charles.

$$p = \tfrac{1}{3} m N v^2$$

$$p = \tfrac{1}{3} m' N' v'^2$$

pressure and temp =

$$N = N'$$

Place gases in cubes with
and same temperature. for
new temp. we have

$$m v_2^2 = m' v'^2_2$$

and $N = N'$ therefore we
must have

$$p = p'$$

the pressures are the same.

Clausius assumed that the
internal energy of a molecule
at any temperature bore a
certain relation to that of standard
Energy of molecule

$$\tfrac{1}{2} 3 m v^2$$

$$\frac{dv}{dx} - \lambda v \frac{dv}{dx} = 0$$

Kinetic energy per unit vol.

$$T = \tfrac{1}{2} 3 n k v^2$$

$$= \tfrac{3}{2} 3 p = T$$

$$T_m = \tfrac{3}{2} 3 p v$$

Kinetic energy per unit mass.

To calculate specific heat of constant vol. = rate of increase in energy per unit rise of temperature

$$K_v = \frac{d T_m}{d \theta}$$

$$= \tfrac{3}{2} 3 v \frac{dp}{d\theta}$$

but we have

$$\frac{pv}{\theta} = C$$

$$K_v = \tfrac{3}{2} 3 v \frac{k}{\theta} = Const.$$

The specific heat of constant vol is constant.

The specific heat of gases are
inversely proportional to their densities.

$$K_v \delta = \text{Const.}$$

Law of Dulong & Petit.

$$\gamma = \frac{K_p}{K_v}$$

$$K_p - K_v = \frac{p_0}{\theta}$$

$$\gamma - 1 = \frac{p_0}{\theta} \cdot \frac{2}{3} \cdot \frac{\theta}{p} \cdot \frac{1}{B_4}$$

$$\gamma = \frac{2}{3B} + 1$$

$u = \sqrt{p_0 v} =$ velocity of sound.

$$v^2 = 3 p_0 v.$$

$$u = \sqrt{\frac{\gamma}{3}}.$$

If $B = 1$ then we have

$$\gamma = 1.64 +$$

This is the smallest value of γ

for then there is an internal
energy. And therefore 1.64
is the largest value of δ.

Hydrogen at 0°

V = 6100 ft per sec.

Free Path = 74 ten millionths of an inch.

Collisions = 9480 Millions per second

Mass of single molecule = 1 M.M.M. = $(10000)^{-3}$

= 1 milligram = 10^{18} molecules weigh 1 mg.

Number = 31 M.M.M = 1 cubic inch.

$$y_{n} = x^{n+1} (-1)^{n} \frac{d^{n}}{dh_{1} dh_{11} dh_{111} \cdots dh_{n}} \left(\frac{1}{r}\right)$$

Finis page 72.

$$\frac{P_n}{P_{n+1}} \quad \frac{n}{n} \quad \frac{n^n}{n}$$

select)

$$\frac{d^2}{dx^2} + \frac{d^2}{dy^2} + \frac{d^2}{dz^2} + \frac{1}{x}\frac{d}{dx} = 0$$

V

$r' \cos(l' - \lambda') \cos b' = \rho' \cos\beta + R_c'$

$r' \sin(l' - \lambda') \cos b' = R_s'$

$r' \sin b' = \rho' \sin\beta'$

$\sin^2 f'' = \sin^2 1/2 (b''' - b') \cos b' \cos b'''$

$+ \sin^2 1/2 (l''' - l'')$

Aus d 3 ersten Formeln in

$r''', l''', \lambda''', b''', \beta''', R_c''', R_s'''$

Wie die Ephem. so ziemlich accurate, kann man zu pars b VI – VII

$\frac{r}{r''} = \frac{\tau'}{\tau'''} (1 - \varkappa \zeta'')$

$\frac{1}{r''} = \frac{\tau''}{\tau'''} (1 - \varkappa \zeta')$

$r'' \sin 2f''' = r''' r'' \sin 2f''$

$r'' \cos 2f''' = r' r + r'' r'' \cos 2f''$

für Luftw.)

$r'' \sin 2f' = r' r \sin 2f''$

$r'' \cos 2f' = r''' r'' + r' r \cos 2f''$

Con d' anular formulae in
n°. n''. T'. T. T'' etc

VII

η	η'	η'''	η_0'	η_0''	η''	
T	T'	T'''	T_0'	T_0''	T''	
f	f'	f'''	f_0'	f_0''	f''	
n	n''	n'	n_0''	n'	n	
n_1	n'''	n_0''	n_0'''	n_0''	n'''	

$$M = \frac{T^2}{(2\cos f \sqrt{n n_0})^3} \qquad \tan(45^\circ + w) = \sqrt[4]{\frac{n'}{n}}$$

$$k = \frac{M}{\frac{5}{6} + l + \text{etc}} \qquad l = \frac{\sin^2 \frac{1}{2} f + \tan^2 2w}{\cos f}$$

$$(\eta - 1) = \frac{k}{\eta_2}(\eta + 1/\eta)$$

$$\log 1/\eta = 9.0433\text{-}78\text{-}51^-$$

m

Table $\overline{IX}$ gives and argum h the value of $\log \eta^2$.

Table $\overline{X}$ gives with the argument $\frac{m}{\eta^2} - l = x$ the value of $\delta\delta$.

As an approx. use in first formula $\chi = \sin^{-1} \frac{1}{2} f$.

(This x is not the same as χ)

$\overline{VIII}$

$$y = \frac{(\eta' - 1) - (\eta''' - 1)}{\eta' x}$$

$$y' = \frac{(\eta'' - 1) - (\eta''' - 1)}{\eta'' x}$$

$$y_0' = \frac{(\eta_0 - 1) - (\eta_0''' - 1}{\eta_0' x}$$

$$y_0' = \frac{(y'' - 1) - (y_0''' - 1)}{y''x}$$

These values are substituted

in $\overline{III}$ in place of former

ones.

L

$\log \cos \beta'$

$\log p'$

$\log p' \cos \beta'$

$\log R_c'$

$\log [p' \cos \beta' + R_c']$

$\log R_s'$

$\log \tan (l' - \lambda')$

$l' - \lambda'$

l' $20^\circ\ 22'\ 15.6''$ $61^\circ\ 44'\ 38.4''$

$\log \sin \beta'$

$\log \sin \iota'$

$\log \sin \eta'$

η' $1^\circ\ 54'\ 49.''$ $0^\circ\ 32'\ 10.''$

ι'

$\log \cos \iota'$

$\log \sin (\iota' - \lambda')$

Two Columns

$\log r'$
$\log R_s'$ } check

$\frac{1}{2}(l''' - l')$

$\log \sin \frac{1}{2}(l''' - l')$

$\log \operatorname{cos} b'$

$\log \operatorname{cos} b'''$

$\log (\text{product})$

$\frac{1}{2}(b''' - b')$ $\quad -\ 0^\circ\ 40^\circ\ 5\text{-}2''$

$\log \sin \frac{1}{2}(b''' - b')$

$\log \sin \frac{1}{2} b''$

b'' $\quad 2^\circ\ 2'\ 2\text{-}1''.5$

$2\, b''$

$\frac{1}{2} b''$

Two Col VI

log y''

log x

log y'

log x y''

log x y'

log (1 - x y'') 1st 9.9626 10
1st 9.9675 30

log r ÷ r'''

log (1 - x y')

log r'' ÷ r'''

log m ÷ m''

log 1 ÷ m''
1st el. 9.8640 71
log m = '' 9.3795 84

log n'

log n'' sin 2f''

log n'' cos 2f''

Two Column

log cos 2f''

log n' m cos 2f''

log n''' n''

log n''' m''' cos 2f''

log n' m

log n'' sin 2f'''

log n' cos 2f'''

log tan 2f'''
2f''' 1st el 12° 07' 16.3
2f''' 2d el 32° 16' 50.1

cos 2f'''

log n''

log n'' sin f'

log n'' cos f'

log tan 2f' 1st el. 27° 05' 27.1
2d el. 8° 23' 49.4

cos 2f'

log n''

log n'' sin f'

log n'' cos f'

log tan 2f'

log n''

$\lambda' - L'$

$\cos(\lambda' - L')$

$\cos\beta'$

$\sin(\lambda' - L')$

$\cos\psi'$

$\sin\psi' \sin P'$

$\quad " \quad \cos P'$

$\tan P'$

$\sin\psi'$

$\log f_1$

$\log B_1$

$\log R'_1$

$\log R'_2$

$\log T'''$

$\log T''$

$\log T' \div T'''$

$\log T'' \div T'''$

$\log(1)$

$\log(2)$

$\log(3)$

(1)

(2)

C

a

II

$T''' - T''$

$T'' - T'$

$T''' - T'$

$\log(T''' - T'')$

$\log(T'' - T')$

$\log(T''' - T')$

$\log\tau'$

$\log\tau'''$

$\log\tau''$

$\log\tau' \div \tau'''$

$\log\tau'' \div \tau'''$

---

days

$1+\mathrm{III}\,x$

$\mathrm{II}+\mathrm{IV}\,x$

$\log(1+\mathrm{III}\,x)$

$\log(\mathrm{II}+\mathrm{IV}\,x)$

$\log\rho'$

ρ'

$\sqrt{1-\mathrm{VIII}\,x}$

$\log(\quad)$

$\log\rho'(\quad)$

$\rho'(\quad)$

ρ'''

$\rho'-f_1$

$\rho'''-f_{\mathrm{III}}$

$\log(\rho'-f_1)$

$\log\beta_1$

$\log\sin\Theta_1$

$\log\cos\Theta_1$

$\log(\rho'''-f_{\mathrm{III}})$

$\log\beta_{\mathrm{III}}$

$\log\sin\Theta_{\mathrm{III}}$

$\log\sin\Theta_{\mathrm{III}}$

$\log\alpha'$

$\log\alpha'''$

z'

z''''

$z'+z'''$

$\log(z'+z''')$

$\log(\quad)^2$

$\log\frac{1}{2}$

$\log\frac{1}{2}(z'+z''')$

$\log\frac{1}{2}$

$\log v$

$$\cos\varphi_1 = \cos\beta' \cos(\lambda' - L')$$

$$\sin\varphi_1 \cos P_1 = \cos\beta' \sin(\lambda' - L')$$

$$\sin\varphi_1 \sin P_1 = \sin\beta'$$

$$s_1 = R' \cos\varphi_1$$

$$B_1 = R' \sin\varphi_1$$

$$R_s' = R' \sin(\lambda' - L')$$

$$R_e' = -R' \cos(\lambda' - L')$$

---

same formulae with φ''', β''' λ''', L''', R''' φ''' etc -

II

$$\tau' = k(T''' - T'')$$

$$T''' = k(T'' - T')$$

$$\tau'' = k(T''' - T')$$

$$T_0' = k(T'' - T_0)$$

$$T_1''' = k(T_0'' - T'')$$

$$\log k = 8.2335814$$

328
227
221

748

183
78

791
341

120
81

320

201

$$\frac{T'}{T''}\,A = (1) \qquad \frac{T_0'}{T_0''}\,A_0 = (1)_0$$

$$-\frac{T'}{T''}\,B = (2) \qquad -\frac{T_0'}{T_0''}\,B_0 = (2)_0$$

$$\frac{T'}{T''}\,C = (3) \qquad \frac{T_0'}{T_0''}\,C_0 = (3)_0$$

$$a = (1) + (2) + C \qquad a_0 = (1)_0 + (2)_0 + C_0$$

$$\underline{I} = a_0 - a \qquad \underline{IV} = (3) - (3)_0$$

$$\underline{V} = \tfrac{1}{2}(a_0 + a) \qquad \underline{VI} = \tfrac{1}{2}\left[(3) + (3)_0\right]$$

III

$$b = (1)\,y'' + (2)\,y' \qquad b_0 = (1)_0\,y_0'' + (2)_0\,y_0'$$

$$\underline{III} = b - b_0 \qquad \underline{IV} = (3)_0\,y_0'' - (3)\,y''$$

$$\underline{VII} = \tfrac{1}{2}(b + b_0) \qquad \underline{VIII} = \tfrac{1}{2}\left\{(3)_0\,y_0'' + (3)\,y''\right\}$$

for the first approx. use

$$\gamma'' = \tfrac{1}{3}(T' - T''^2) \qquad \gamma_0''' = \tfrac{1}{3}(T_0'^2 - T_0'''^2)$$

$$\gamma' = \tfrac{1}{3}(T''^2 - T'''^2) \qquad \gamma_0'' = \tfrac{1}{3}(T''^2 - T_0'''^2)$$

and determine better values of γ's from formulae VIII

w/

17

$$\rho' = \frac{I + III\,x}{II + IV\,x}$$

$$\frac{\rho' - f_1'}{B_1'} = \tan \theta_1'$$

$$\frac{\rho''' - f'''}{B'''} = \tan \theta'''$$

$$\rho''' = V - VII\,x + (VI - VIII\,x)\rho'$$

$$r' = (\rho - f_1')\sec \theta_1'$$

$$r''' = (\rho''' - f''')\sec \theta'''$$

X.

$$\begin{cases} z = \dots \\ z' = \dots \end{cases}$$

$$\frac{\dots}{\dots} = \lambda$$

Aer thermom

Ser plenum -

Pt	Cubo
28.85	53.98
28.89	53.95
28.84	54.01
28.90	53.98
28.9	54

Barom. 768.90 .02

Attach. tbe 23.4

Cong bar. 31.145

1101

$x^3 - 1101 = 0$

$\log 0.000484 = \bar{4}.684853$

$\log 99.0469 = 1.999803$

$\operatorname{colog} 17.779 = 8.750157$

$\bar{3}.434298$

$\frac{t-t'}{2}(h-h')L = -0.002711$

$\frac{t^2+t'^2}{2} + 1.103055$

$\text{Den} = 1.100344$

$\log \pi^2 = 0.994330$

$\log L = 17.999803$

$\operatorname{colog} 1.ms = 9.999684$

2.993817

$= 982.1$

$g = 980.133.$

An error of 1 mm $\begin{cases} 980.115. \text{ meters } n-h' \\ 980.137. \text{ dens } h-h \end{cases}$

by both formulæ. an error of 1 mm

changes result by 12 mm

$$Q = \frac{\pi^2 L}{\sqrt{\frac{t^2 + t'^2}{2} + \frac{t^2 - t'^2}{2(h - h_1)} \cdot L}}$$

Q = cloat the can ve.

$$\log a = 1.76837 = 58.1664$$

$$\log b = 1.61347 = 40.8655$$

$$\log \frac{b}{a} = 1.84510 = 17.7799$$

$$\frac{L}{2} = 1.$$

$$L = 1.$$

$$t_2' = 1.0035\text{-}43$$

$$t^2 = 1.0021\text{-}74$$

$$2) \; 2.0056117$$

$$\tfrac{1}{2}(t^2 + t'^2) = 1.0028058$$

$$(t^2 - t'^2) = -0.000969$$

$$\tfrac{1}{2}(t^2 - t'^2) = -0.000484$$

44.179
43.668
0.511 $m'-m$

$m = 384.760$

$m = \frac{343.668}{341.032}$

$m-m$

$\lambda' = 00,2400$

$m-1$

log 0.511 = $\bar{1}.7084$

colog 341.03 = 7.4671

colog .1012 = 12.9208

log 1.108 = 0.0441

0.1408

1.382

\+ 1.108

2.490

Beds and Mattress

L
Beds

12
272.3

L
Beds

12
272.4

11

12

3.2

5

10.8

3.2

3.079

0.0436

0.0436

2.

7330

7330

0.70630

L
272.3

12
Beds

9.8

0.00365

37

0.3665

7.8

9.8

6

9.1

0.18321

0.18691

.5328

1.08691

1.0706

1.07064) 1.18691.00 (1.108
1.0706

11631

10706

9 2000

Repeat Accuracy in Glass

14.2

12.2

9.2 11.1

9.6 11.1

Glass 1

L R

9.2 12.7

9.6 12.6

9.6

Glass 2

L R

6.8 15.6

6.8 15.5

7.1

Glass 3

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 4

L R

9.2 15.5

6.8

22.3

11.17

Glass 5

L R

4.2 15.8

4.6 15

5

Glass 6

L R

3.674

4.2 15.8

4.6 15

5

Glass 7

L R

4.6 15.4

4.6 4.6

20.

10.

Glass 8

L R

3.733

15.5

6.8

22.3

11.17

Glass 9

L R

6.5

6.8 20.4/6

7.1

Glass 10

L R

3.733

15.5

6.8

22.3

11.17

Glass 11

L R

6.5

6.8 20.4/6

7.1

Glass 12

L R

3.674

4.2 15.8

4.6 15

5

Glass 13

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 14

L R

4.6 15.4

4.6 4.6

20.

10.

Glass 15

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 16

L R

3.733

15.5

6.8

22.3

11.17

Glass 17

L R

6.5

6.8 20.4/6

7.1

Glass 18

L R

3.674

4.2 15.8

4.6 15

5

Glass 19

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 20

L R

4.6 15.4

4.6 4.6

20.

10.

Glass 21

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 22

L R

3.733

15.5

6.8

22.3

11.17

Glass 23

L R

6.5

6.8 20.4/6

7.1

Glass 24

L R

3.674

4.2 15.8

4.6 15

5

Glass 25

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 26

L R

4.6 15.4

4.6 4.6

20.

10.

Glass 27

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 28

L R

3.733

15.5

6.8

22.3

11.17

Glass 29

L R

6.5

6.8 20.4/6

7.1

Glass 30

L R

3.674

4.2 15.8

4.6 15

5

Glass 31

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 32

L R

4.6 15.4

4.6 4.6

20.

10.

Glass 33

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 34

L R

3.733

15.5

6.8

22.3

11.17

Glass 35

L R

6.5

6.8 20.4/6

7.1

Glass 36

L R

3.674

4.2 15.8

4.6 15

5

Glass 37

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 38

L R

4.6 15.4

4.6 4.6

20.

10.

Glass 39

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 40

L R

3.733

15.5

6.8

22.3

11.17

Glass 41

L R

6.5

6.8 20.4/6

7.1

Glass 42

L R

3.674

4.2 15.8

4.6 15

5

Glass 43

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 44

L R

4.6 15.4

4.6 4.6

20.

10.

Glass 45

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 46

L R

3.733

15.5

6.8

22.3

11.17

Glass 47

L R

6.5

6.8 20.4/6

7.1

Glass 48

L R

3.674

4.2 15.8

4.6 15

5

Glass 49

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 50

L R

4.6 15.4

4.6 4.6

20.

10.

Glass 51

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 52

L R

3.733

15.5

6.8

22.3

11.17

Glass 53

L R

6.5

6.8 20.4/6

7.1

Glass 54

L R

3.674

4.2 15.8

4.6 15

5

Glass 55

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 56

L R

4.6 15.4

4.6 4.6

20.

10.

Glass 57

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 58

L R

3.733

15.5

6.8

22.3

11.17

Glass 59

L R

6.5

6.8 20.4/6

7.1

Glass 60

L R

3.674

4.2 15.8

4.6 15

5

Glass 61

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 62

L R

4.6 15.4

4.6 4.6

20.

10.

Glass 63

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 64

L R

3.733

15.5

6.8

22.3

11.17

Glass 65

L R

6.5

6.8 20.4/6

7.1

Glass 66

L R

3.674

4.2 15.8

4.6 15

5

Glass 67

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 68

L R

4.6 15.4

4.6 4.6

20.

10.

Glass 69

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 70

L R

3.733

15.5

6.8

22.3

11.17

Glass 71

L R

6.5

6.8 20.4/6

7.1

Glass 72

L R

3.674

4.2 15.8

4.6 15

5

Glass 73

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 74

L R

4.6 15.4

4.6 4.6

20.

10.

Glass 75

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 76

L R

3.733

15.5

6.8

22.3

11.17

Glass 77

L R

6.5

6.8 20.4/6

7.1

Glass 78

L R

3.674

4.2 15.8

4.6 15

5

Glass 79

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 80

L R

4.6 15.4

4.6 4.6

20.

10.

Glass 81

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 82

L R

3.733

15.5

6.8

22.3

11.17

Glass 83

L R

6.5

6.8 20.4/6

7.1

Glass 84

L R

3.674

4.2 15.8

4.6 15

5

Glass 85

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 86

L R

4.6 15.4

4.6 4.6

20.

10.

Glass 87

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 88

L R

3.733

15.5

6.8

22.3

11.17

Glass 89

L R

6.5

6.8 20.4/6

7.1

Glass 90

L R

3.674

4.2 15.8

4.6 15

5

Glass 91

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 92

L R

4.6 15.4

4.6 4.6

20.

10.

Glass 93

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 94

L R

3.733

15.5

6.8

22.3

11.17

Glass 95

L R

6.5

6.8 20.4/6

7.1

Glass 96

L R

3.674

4.2 15.8

4.6 15

5

Glass 97

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 98

L R

4.6 15.4

4.6 4.6

20.

10.

Glass 99

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 100

L R

3.733

15.5

6.8

22.3

11.17

Glass 101

L R

6.5

6.8 20.4/6

7.1

Glass 102

L R

3.674

4.2 15.8

4.6 15

5

Glass 103

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 104

L R

4.6 15.4

4.6 4.6

20.

10.

Glass 105

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 106

L R

3.733

15.5

6.8

22.3

11.17

Glass 107

L R

6.5

6.8 20.4/6

7.1

Glass 108

L R

3.674

4.2 15.8

4.6 15

5

Glass 109

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 110

L R

4.6 15.4

4.6 4.6

20.

10.

Glass 111

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 112

L R

3.733

15.5

6.8

22.3

11.17

Glass 113

L R

6.5

6.8 20.4/6

7.1

Glass 114

L R

3.674

4.2 15.8

4.6 15

5

Glass 115

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 116

L R

4.6 15.4

4.6 4.6

20.

10.

Glass 117

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 118

L R

3.733

15.5

6.8

22.3

11.17

Glass 119

L R

6.5

6.8 20.4/6

7.1

Glass 120

L R

3.674

4.2 15.8

4.6 15

5

Glass 121

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 122

L R

4.6 15.4

4.6 4.6

20.

10.

Glass 123

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 124

L R

3.733

15.5

6.8

22.3

11.17

Glass 125

L R

6.5

6.8 20.4/6

7.1

Glass 126

L R

3.674

4.2 15.8

4.6 15

5

Glass 127

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 128

L R

4.6 15.4

4.6 4.6

20.

10.

Glass 129

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 130

L R

3.733

15.5

6.8

22.3

11.17

Glass 131

L R

6.5

6.8 20.4/6

7.1

Glass 132

L R

3.674

4.2 15.8

4.6 15

5

Glass 133

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 134

L R

4.6 15.4

4.6 4.6

20.

10.

Glass 135

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 136

L R

3.733

15.5

6.8

22.3

11.17

Glass 137

L R

6.5

6.8 20.4/6

7.1

Glass 138

L R

3.674

4.2 15.8

4.6 15

5

Glass 139

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 140

L R

4.6 15.4

4.6 4.6

20.

10.

Glass 141

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 142

L R

3.733

15.5

6.8

22.3

11.17

Glass 143

L R

6.5

6.8 20.4/6

7.1

Glass 144

L R

3.674

4.2 15.8

4.6 15

5

Glass 145

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 146

L R

4.6 15.4

4.6 4.6

20.

10.

Glass 147

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 148

L R

3.733

15.5

6.8

22.3

11.17

Glass 149

L R

6.5

6.8 20.4/6

7.1

Glass 150

L R

3.674

4.2 15.8

4.6 15

5

Glass 151

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 152

L R

4.6 15.4

4.6 4.6

20.

10.

Glass 153

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 154

L R

3.733

15.5

6.8

22.3

11.17

Glass 155

L R

6.5

6.8 20.4/6

7.1

Glass 156

L R

3.674

4.2 15.8

4.6 15

5

Glass 157

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 158

L R

4.6 15.4

4.6 4.6

20.

10.

Glass 159

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 160

L R

3.733

15.5

6.8

22.3

11.17

Glass 161

L R

6.5

6.8 20.4/6

7.1

Glass 162

L R

3.674

4.2 15.8

4.6 15

5

Glass 163

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 164

L R

4.6 15.4

4.6 4.6

20.

10.

Glass 165

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 166

L R

3.733

15.5

6.8

22.3

11.17

Glass 167

L R

6.5

6.8 20.4/6

7.1

Glass 168

L R

3.674

4.2 15.8

4.6 15

5

Glass 169

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 170

L R

4.6 15.4

4.6 4.6

20.

10.

Glass 171

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 172

L R

3.733

15.5

6.8

22.3

11.17

Glass 173

L R

6.5

6.8 20.4/6

7.1

Glass 174

L R

3.674

4.2 15.8

4.6 15

5

Glass 175

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 176

L R

4.6 15.4

4.6 4.6

20.

10.

Glass 177

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 178

L R

3.733

15.5

6.8

22.3

11.17

Glass 179

L R

6.5

6.8 20.4/6

7.1

Glass 180

L R

3.674

4.2 15.8

4.6 15

5

Glass 181

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 182

L R

4.6 15.4

4.6 4.6

20.

10.

Glass 183

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 184

L R

3.733

15.5

6.8

22.3

11.17

Glass 185

L R

6.5

6.8 20.4/6

7.1

Glass 186

L R

3.674

4.2 15.8

4.6 15

5

Glass 187

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 188

L R

4.6 15.4

4.6 4.6

20.

10.

Glass 189

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 190

L R

3.733

15.5

6.8

22.3

11.17

Glass 191

L R

6.5

6.8 20.4/6

7.1

Glass 192

L R

3.674

4.2 15.8

4.6 15

5

Glass 193

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 194

L R

4.6 15.4

4.6 4.6

20.

10.

Glass 195

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 196

L R

3.733

15.5

6.8

22.3

11.17

Glass 197

L R

6.5

6.8 20.4/6

7.1

Glass 198

L R

3.674

4.2 15.8

4.6 15

5

Glass 199

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 200

L R

4.6 15.4

4.6 4.6

20.

10.

Glass 201

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 202

L R

3.733

15.5

6.8

22.3

11.17

Glass 203

L R

6.5

6.8 20.4/6

7.1

Glass 204

L R

3.674

4.2 15.8

4.6 15

5

Glass 205

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 206

L R

4.6 15.4

4.6 4.6

20.

10.

Glass 207

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 208

L R

3.733

15.5

6.8

22.3

11.17

Glass 209

L R

6.5

6.8 20.4/6

7.1

Glass 210

L R

3.674

4.2 15.8

4.6 15

5

Glass 211

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 212

L R

4.6 15.4

4.6 4.6

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10.

Glass 213

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 214

L R

3.733

15.5

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22.3

11.17

Glass 215

L R

6.5

6.8 20.4/6

7.1

Glass 216

L R

3.674

4.2 15.8

4.6 15

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Glass 217

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 218

L R

4.6 15.4

4.6 4.6

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Glass 219

L R

6.2 16.2

7.5 15.4

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7.3 15.7

Glass 220

L R

3.733

15.5

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22.3

11.17

Glass 221

L R

6.5

6.8 20.4/6

7.1

Glass 222

L R

3.674

4.2 15.8

4.6 15

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Glass 223

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 224

L R

4.6 15.4

4.6 4.6

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Glass 225

L R

6.2 16.2

7.5 15.4

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7.3 15.7

Glass 226

L R

3.733

15.5

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22.3

11.17

Glass 227

L R

6.5

6.8 20.4/6

7.1

Glass 228

L R

3.674

4.2 15.8

4.6 15

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Glass 229

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6.2 16.2

7.5 15.4

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7.3 15.7

Glass 230

L R

4.6 15.4

4.6 4.6

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Glass 231

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6.2 16.2

7.5 15.4

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7.3 15.7

Glass 232

L R

3.733

15.5

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22.3

11.17

Glass 233

L R

6.5

6.8 20.4/6

7.1

Glass 234

L R

3.674

4.2 15.8

4.6 15

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Glass 235

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 236

L R

4.6 15.4

4.6 4.6

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Glass 237

L R

6.2 16.2

7.5 15.4

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7.3 15.7

Glass 238

L R

3.733

15.5

6.8

22.3

11.17

Glass 239

L R

6.5

6.8 20.4/6

7.1

Glass 240

L R

3.674

4.2 15.8

4.6 15

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Glass 241

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 242

L R

4.6 15.4

4.6 4.6

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Glass 243

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 244

L R

3.733

15.5

6.8

22.3

11.17

Glass 245

L R

6.5

6.8 20.4/6

7.1

Glass 246

L R

3.674

4.2 15.8

4.6 15

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Glass 247

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 248

L R

4.6 15.4

4.6 4.6

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Glass 249

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 250

L R

3.733

15.5

6.8

22.3

11.17

Glass 251

L R

6.5

6.8 20.4/6

7.1

Glass 252

L R

3.674

4.2 15.8

4.6 15

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Glass 253

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 254

L R

4.6 15.4

4.6 4.6

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Glass 255

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 256

L R

3.733

15.5

6.8

22.3

11.17

Glass 257

L R

6.5

6.8 20.4/6

7.1

Glass 258

L R

3.674

4.2 15.8

4.6 15

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Glass 259

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 260

L R

4.6 15.4

4.6 4.6

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Glass 261

L R

6.2 16.2

7.5 15.4

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7.3 15.7

Glass 262

L R

3.733

15.5

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22.3

11.17

Glass 263

L R

6.5

6.8 20.4/6

7.1

Glass 264

L R

3.674

4.2 15.8

4.6 15

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Glass 265

L R

6.2 16.2

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8.4

7.3 15.7

Glass 266

L R

4.6 15.4

4.6 4.6

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Glass 267

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6.2 16.2

7.5 15.4

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7.3 15.7

Glass 268

L R

3.733

15.5

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22.3

11.17

Glass 269

L R

6.5

6.8 20.4/6

7.1

Glass 270

L R

3.674

4.2 15.8

4.6 15

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Glass 271

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 272

L R

4.6 15.4

4.6 4.6

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Glass 273

L R

6.2 16.2

7.5 15.4

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7.3 15.7

Glass 274

L R

3.733

15.5

6.8

22.3

11.17

Glass 275

L R

6.5

6.8 20.4/6

7.1

Glass 276

L R

3.674

4.2 15.8

4.6 15

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Glass 277

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 278

L R

4.6 15.4

4.6 4.6

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Glass 279

L R

6.2 16.2

7.5 15.4

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7.3 15.7

Glass 280

L R

3.733

15.5

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22.3

11.17

Glass 281

L R

6.5

6.8 20.4/6

7.1

Glass 282

L R

3.674

4.2 15.8

4.6 15

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Glass 283

L R

6.2 16.2

7.5 15.4

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7.3 15.7

Glass 284

L R

4.6 15.4

4.6 4.6

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Glass 285

L R

6.2 16.2

7.5 15.4

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7.3 15.7

Glass 286

L R

3.733

15.5

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22.3

11.17

Glass 287

L R

6.5

6.8 20.4/6

7.1

Glass 288

L R

3.674

4.2 15.8

4.6 15

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Glass 289

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 290

L R

4.6 15.4

4.6 4.6

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Glass 291

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 292

L R

3.733

15.5

6.8

22.3

11.17

Glass 293

L R

6.5

6.8 20.4/6

7.1

Glass 294

L R

3.674

4.2 15.8

4.6 15

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Glass 295

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 296

L R

4.6 15.4

4.6 4.6

20.

10.

Glass 297

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 298

L R

3.733

15.5

6.8

22.3

11.17

Glass 299

L R

6.5

6.8 20.4/6

7.1

Glass 300

L R

3.674

4.2 15.8

4.6 15

5

Glass 301

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 302

L R

4.6 15.4

4.6 4.6

20.

10.

Glass 303

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 304

L R

3.733

15.5

6.8

22.3

11.17

Glass 305

L R

6.5

6.8 20.4/6

7.1

Glass 306

L R

3.674

4.2 15.8

4.6 15

5

Glass 307

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 308

L R

4.6 15.4

4.6 4.6

20.

10.

Glass 309

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 310

L R

3.733

15.5

6.8

22.3

11.17

Glass 311

L R

6.5

6.8 20.4/6

7.1

Glass 312

L R

3.674

4.2 15.8

4.6 15

5

Glass 313

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 314

L R

4.6 15.4

4.6 4.6

20.

10.

Glass 315

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 316

L R

3.733

15.5

6.8

22.3

11.17

Glass 317

L R

6.5

6.8 20.4/6

7.1

Glass 318

L R

3.674

4.2 15.8

4.6 15

5

Glass 319

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 320

L R

4.6 15.4

4.6 4.6

20.

10.

Glass 321

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 322

L R

3.733

15.5

6.8

22.3

11.17

Glass 323

L R

6.5

6.8 20.4/6

7.1

Glass 324

L R

3.674

4.2 15.8

4.6 15

5

Glass 325

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 326

L R

4.6 15.4

4.6 4.6

20.

10.

Glass 327

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 328

L R

3.733

15.5

6.8

22.3

11.17

Glass 329

L R

6.5

6.8 20.4/6

7.1

Glass 330

L R

3.674

4.2 15.8

4.6 15

5

Glass 331

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 332

L R

4.6 15.4

4.6 4.6

20.

10.

Glass 333

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 334

L R

3.733

15.5

6.8

22.3

11.17

Glass 335

L R

6.5

6.8 20.4/6

7.1

Glass 336

L R

3.674

4.2 15.8

4.6 15

5

Glass 337

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 338

L R

4.6 15.4

4.6 4.6

20.

10.

Glass 339

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 340

L R

3.733

15.5

6.8

22.3

11.17

Glass 341

L R

6.5

6.8 20.4/6

7.1

Glass 342

L R

3.674

4.2 15.8

4.6 15

5

Glass 343

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 344

L R

4.6 15.4

4.6 4.6

20.

10.

Glass 345

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 346

L R

3.733

15.5

6.8

22.3

11.17

Glass 347

L R

6.5

6.8 20.4/6

7.1

Glass 348

L R

3.674

4.2 15.8

4.6 15

5

Glass 349

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 350

L R

4.6 15.4

4.6 4.6

20.

10.

Glass 351

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 352

L R

3.733

15.5

6.8

22.3

11.17

Glass 353

L R

6.5

6.8 20.4/6

7.1

Glass 354

L R

3.674

4.2 15.8

4.6 15

5

Glass 355

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 356

L R

4.6 15.4

4.6 4.6

20.

10.

Glass 357

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 358

L R

3.733

15.5

6.8

22.3

11.17

Glass 359

L R

6.5

6.8 20.4/6

7.1

Glass 360

L R

3.674

4.2 15.8

4.6 15

5

Glass 361

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 362

L R

4.6 15.4

4.6 4.6

20.

10.

Glass 363

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 364

L R

3.733

15.5

6.8

22.3

11.17

Glass 365

L R

6.5

6.8 20.4/6

7.1

Glass 366

L R

3.674

4.2 15.8

4.6 15

5

Glass 367

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 368

L R

4.6 15.4

4.6 4.6

20.

10.

Glass 369

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 370

L R

3.733

15.5

6.8

22.3

11.17

Glass 371

L R

6.5

6.8 20.4/6

7.1

Glass 372

L R

3.674

4.2 15.8

4.6 15

5

Glass 373

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 374

L R

4.6 15.4

4.6 4.6

20.

10.

Glass 375

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 376

L R

3.733

15.5

6.8

22.3

11.17

Glass 377

L R

6.5

6.8 20.4/6

7.1

Glass 378

L R

3.674

4.2 15.8

4.6 15

5

Glass 379

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 380

L R

4.6 15.4

4.6 4.6

20.

10.

Glass 381

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 382

L R

3.733

15.5

6.8

22.3

11.17

Glass 383

L R

6.5

6.8 20.4/6

7.1

Glass 384

L R

3.674

4.2 15.8

4.6 15

5

Glass 385

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 386

L R

4.6 15.4

4.6 4.6

20.

10.

Glass 387

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 388

L R

3.733

15.5

6.8

22.3

11.17

Glass 389

L R

6.5

6.8 20.4/6

7.1

Glass 390

L R

3.674

4.2 15.8

4.6 15

5

Glass 391

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 392

L R

4.6 15.4

4.6 4.6

20.

10.

Glass 393

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 394

L R

3.733

15.5

6.8

22.3

11.17

Glass 395

L R

6.5

6.8 20.4/6

7.1

Glass 396

L R

3.674

4.2 15.8

4.6 15

5

Glass 397

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 398

L R

4.6 15.4

4.6 4.6

20.

10.

Glass 399

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 400

L R

3.733

15.5

6.8

22.3

11.17

Glass 401

L R

6.5

6.8 20.4/6

7.1

Glass 402

L R

3.674

4.2 15.8

4.6 15

5

Glass 403

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 404

L R

4.6 15.4

4.6 4.6

20.

10.

Glass 405

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 406

L R

3.733

15.5

6.8

22.3

11.17

Glass 407

L R

6.5

6.8 20.4/6

7.1

Glass 408

L R

3.674

4.2 15.8

4.6 15

5

Glass 409

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 410

L R

4.6 15.4

4.6 4.6

20.

10.

Glass 411

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 412

L R

3.733

15.5

6.8

22.3

11.17

Glass 413

L R

6.5

6.8 20.4/6

7.1

Glass 414

L R

3.674

4.2 15.8

4.6 15

5

Glass 415

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 416

L R

4.6 15.4

4.6 4.6

20.

10.

Glass 417

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 418

L R

3.733

15.5

6.8

22.3

11.17

Glass 419

L R

6.5

6.8 20.4/6

7.1

Glass 420

L R

3.674

4.2 15.8

4.6 15

5

Glass 421

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 422

L R

4.6 15.4

4.6 4.6

20.

10.

Glass 423

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 424

L R

3.733

15.5

6.8

22.3

11.17

Glass 425

L R

6.5

6.8 20.4/6

7.1

Glass 426

L R

3.674

4.2 15.8

4.6 15

5

Glass 427

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 428

L R

4.6 15.4

4.6 4.6

20.

10.

Glass 429

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 430

L R

3.733

15.5

6.8

22.3

11.17

Glass 431

L R

6.5

6.8 20.4/6

7.1

Glass 432

L R

3.674

4.2 15.8

4.6 15

5

Glass 433

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 434

L R

4.6 15.4

4.6 4.6

20.

10.

Glass 435

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 436

L R

3.733

15.5

6.8

22.3

11.17

Glass 437

L R

6.5

6.8 20.4/6

7.1

Glass 438

L R

3.674

4.2 15.8

4.6 15

5

Glass 439

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 440

L R

4.6 15.4

4.6 4.6

20.

10.

Glass 441

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 442

L R

3.733

15.5

6.8

22.3

11.17

Glass 443

L R

6.5

6.8 20.4/6

7.1

Glass 444

L R

3.674

4.2 15.8

4.6 15

5

Glass 445

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 446

L R

4.6 15.4

4.6 4.6

20.

10.

Glass 447

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 448

L R

3.733

15.5

6.8

22.3

11.17

Glass 449

L R

6.5

6.8 20.4/6

7.1

Glass 450

L R

3.674

4.2 15.8

4.6 15

5

Glass 451

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 452

L R

4.6 15.4

4.6 4.6

20.

10.

Glass 453

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 454

L R

3.733

15.5

6.8

22.3

11.17

Glass 455

L R

6.5

6.8 20.4/6

7.1

Glass 456

L R

3.674

4.2 15.8

4.6 15

5

Glass 457

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 458

L R

4.6 15.4

4.6 4.6

20.

10.

Glass 459

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 460

L R

3.733

15.5

6.8

22.3

11.17

Glass 461

L R

6.5

6.8 20.4/6

7.1

Glass 462

L R

3.674

4.2 15.8

4.6 15

5

Glass 463

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 464

L R

4.6 15.4

4.6 4.6

20.

10.

Glass 465

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 466

L R

3.733

15.5

6.8

22.3

11.17

Glass 467

L R

6.5

6.8 20.4/6

7.1

Glass 468

L R

3.674

4.2 15.8

4.6 15

5

Glass 469

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 470

L R

4.6 15.4

4.6 4.6

20.

10.

Glass 471

L R

6.2 16.2

7.5 15.4

8.4

7.3 15.7

Glass 472

L R

3.733

15.5

6.8

22.3

11.17

Glass 473

L R

6.5

6.8 20.4/6

7.1

Glass 474

L R

3.674

4.2 15.8

4.6 15

5

Glass 475

L R

6.2 16.2

7.5 15.4

8.4

7.3

Sample -

L	R
7.7	13.1
7.8	13
7.4	
7.8	13.6
	7.6
	20.2
	10.1

$\frac{10}{7.1}$

$\frac{P}{L} = \frac{100}{100}$ $\frac{P'}{R} = \frac{100}{100}$

L	R
100	100
7.1	15.5
7.2	15.3
7.4	15.4
7.23	7.2
	30.9
	11.3

L	R
100	100
7.8	14.6
S	14.6
7.93	14.6
	7.93
	29.93
	11.263

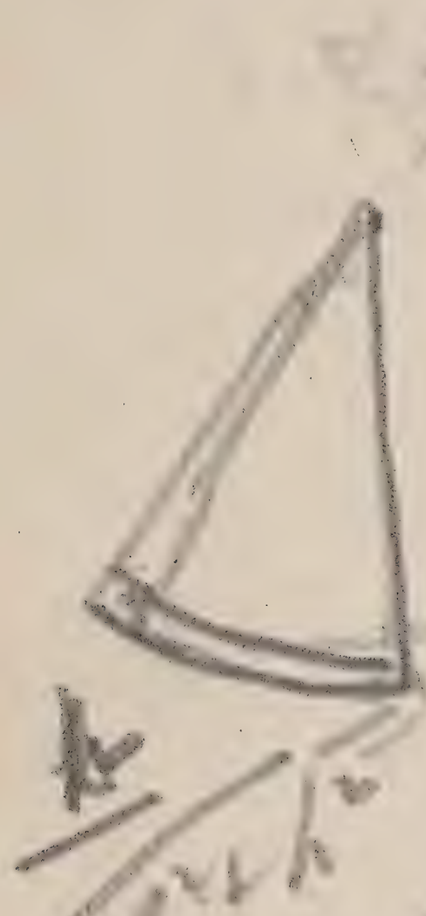
L	R
100	100
5.3	17
5.6	16.7
5.8	16.83
5.63	5.63
	=126.28
	11.24

L	R
10^{-6}	$10^{-6} + .005$
6.7	14.3
6.9	14.1
7	
6.866	14.2
	6.866
	21.066
	10.533

L	R
10^{-6}	$10^{-6} + .005$
5.2	12.7
5.2	12.7
5.12	12.7
	5.12
10.44	25.82
8.91	8.91
1.53	

= 21.— for 1 turn.

L	R
10^{-6}	$10^{-6} + .005$
5.2	15.7
5.13	15.6
5.5	
5.93	15.7
	5.93
	21.63
	10.46



$2\pi\rho h\left(\sqrt{R^2+h^2}\right)$

$2\pi\rho h\left(\sqrt{R^2+h^2}-h\right)=$

$2\pi\rho\frac{h}{\sqrt{R^2+h^2}}$

$2\pi\rho h\left(\sqrt{R^2+h^2}\right)$

$2\pi\rho h\left(\sqrt{R^2+h^2}-h\right)$

$2\pi\rho h\frac{3/4}{5}$

Dis Col Lvs.	CO
98.50 cm	33.2 - 22.78
98.45	33.2 - 22.80
98.47	" 22.75
98.32	" 22.78

3.5

Compressor of Water

A chart of mercury in sheet 22 cm long

Weights	1.14 gm.	Water in tube 2 cc
Log Cubic - Plm	Small Tube	
30.8	29.7	63.2
33.2	25.8	58.2
23.2	22	35.8
67	16.2	-1
	13	

-1	29.3	53	20.2
19	28	41	23.8
25	26.1	31	25.3
31	25.6	21	26.8
41	23.2	13	28
53	20.2	-1	39.1
65	16		

Temp. 24.8 C

Bar. 30.05 in.

$g = \frac{\pi^2(a^2 - b^2)}{at_1^2 - bt_2^2}$ page 230

a, b dist from c. of g - to front of rest.

Pend. slows then clock

Com. 28 m		Com = 79	2
Ends. "	22	Ends = "	12
Com. 37 m	26	Com = 84	26
Ends "	48	Ends "	39
Com. 42	40	Com 99	56
Ends 48	16		
Com 38	57		
Ends 58	34		
Com = 68	36		
Ends "	54		

Pend. reversed

Commences	14		
Fuel	21		
Ends 9 m	34		
Commences 18	31		
Fuel			
Ends "	57		

Bet mk (1) reads 195 1/2 grs.
" (2) " 196 1/2 "
Bar 35 1/2 "

CE 99.5 - 1.236 Tan / 4.0m = 1 m Temp 25.4

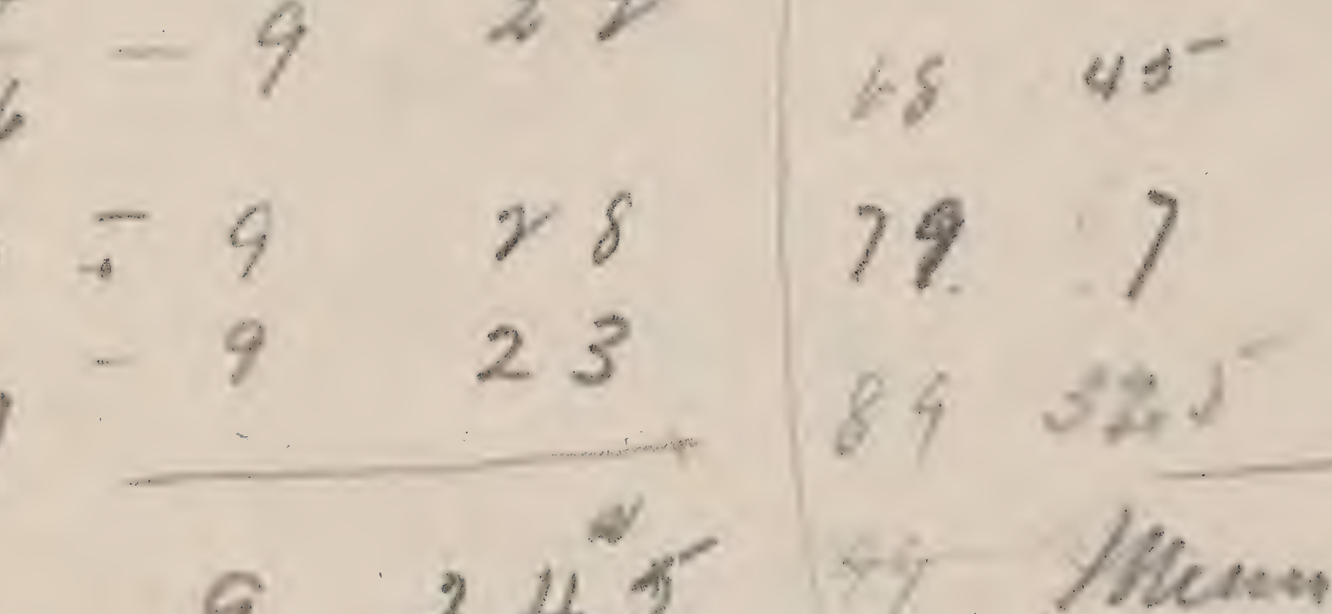
99.5 - 1.23

1000.326 - ab 21.16

Coef. of ref. .002138 for 1°

1st Ten.				2d Ten.			
50	43			47	53		
60	8	- 9m	23-			10m	26.3-
				58	20.3-		24.3-
9	24					10	
18	46	- 9	22	68	43-		22.
28	14	- 9	28			10	
37	37	- 9	23	79	7		20.3-
				89	32.3-	10	
		9m					34.62-
Mean	9	24.3-		Mean 10.			

long end down



17.2

7.7 17

8 16.4

8.1 16.1

$\sqrt{23.28} \times 7.93$ $\sqrt{27.8} \; 16.9$

12.8

8.2 12.8

8.3 12.7

8.5 12.6

10 Sum.

10.8

5.7 10.1 $\sqrt{24.883}$

3.8 10.3 $\sqrt{21.035}$ 10.3^{-29}

4 4 10.3

$\sqrt{11.3} \; 3.633$ $10.3^{-4.3}$ 2.633 $2\sqrt{14.408}$ 7.204

Zero pt.

~~100 grms.~~

17.6

3 17.3

3.2 17.3

3.3 17.4 $\sqrt{3}$

3.433 3.433

$\sqrt{30.705}$ 10.3^{-24}

10 grms

water with —

12.

2.7 11.6

2.7 11.8

2.7 11.6

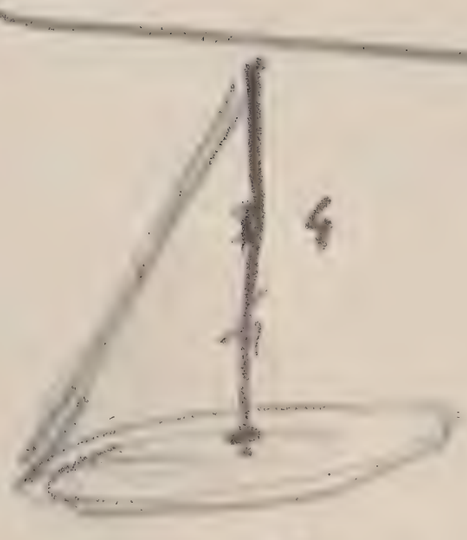
2.7

11.6

2.7

$\sqrt{14.6}$

7.3



$\frac{\pi D^2 d}{4}$ lost.

$\pi h \rho \left(\frac{1}{\cos\theta} - \right.$

50 load
weights changed

10.6	17.4
11	17.3
11.1	
10.9	17.4

Weight changed

10.8

5.6	10.6
5.7	10.5
5.8	10.4
5.7	10.375
	4)16.275
	8.137

100 lbs

	12.4
3.8	
	12.2
4	
	12
4.2	
	11.9
4.	12.125
	4)16.125
	8.062

50 lbs

	11.7
4	
	11.5
4.1	
	11.2
4.05	11.475
	4)15.525
	7.756

200 lbs
was changed.

	11.5
6.4	
	11.3
6.6	
	11.2
6.7	11.1
6.566	11.275
	4)17.841
	8.92

200 load

	13.3
4.6	
	13.2
4.7	
	12.9
5	
	12.8
4)14.3	13.05
4.575	4)17.625
	8.812

278

30

Linz Volmer results

12.30

8.60 — 12.387

8.683

12.00 4/21.073

8.70 10.538 = Gewicht

12.35

8.75

4)34.03

8.683

12.30

4149.93

12.387

X

Ein ab Lem Empfg Semmeln. Lund 10 Gramm und Lem

.01

7.3 — 9.6 — 4.6 — 4.2 — 10.5 — 10.075

7.4 — 8 — 4.7 — 10.1 — 4. Saro

2) 14.7 — 3) 14.8 = 7

7.35 — 7.425

Mem .01 — 8.13 M.

Lund 10 Gramm und Lem

12.5 — 9.423 — 4.2 — 12.8

10.2 — 5.533 — 2.3 — 12.6

9.7 — 4) 14.956 — 2.5 — 12.6

7.479 — 2.8 — 12.2

5.3 — 9.5 — 12.30

5.6 — 9.3 — 2.536

57 — 9.2 — 2.536

3) 16.6 37.7 — 4) 15.036

5.533 — 9.425 — 7.518

1m - 30

Empty .01

12.8

2.2

12.5

2.4 12.

1.2 12.97

2.00

=10.57

7.287

Jerry fill

19.3-

1.6 19.3

1.8 19.

2.1 18.8

23.3-

1.833 19.17

19.13-

1.83

Y 20.918

10.49 — Jerry

Empty

White 1c Y

12.2

2.3-

11.6 12 11.7.6

2.6 14.0

7.28- 11.8

1.7 11.6

1.6 11.9

25 cent Jerry

Lena 10 gm

11.9

2.7 11.7

2.9 11.5-

3.1 11.4 X

2.4 11.825

11.625-

2.6

=14.225

7.267

50 cent Lena

4 Y 12

4 11.8

4.1 11.6

4.3 11.6

4.138 11.8

4.163

=15.963

7.876

25 cent Jerry

11.1

4 10.8

4.2 10.8 Y

4.3 10.7

4.166 10.83

4.163

=15.013

7.508

To find radius of heart of cam of bob

Left cam

P = 200

10" 200

$\frac{L}{R} = \frac{.03" + .05}{400}$

$= \frac{0.14}{400}$

.14
.0140
.00035"

$\frac{L}{R} = .00035"$

Rt. cam

10" = 200 + .5" to work
.2 " "
.1 " "
.03"

P = 200
+.03" to work
+.06
+.07 " "
.09

8.1 12.3"
8.3" 12.2"
8.6 12.3

Sheet 9.6 cube -

Left fan
100 to little
110 to high
105" to little
107 to high
106 to low
+.3" high
.2 low
.3 " 106.93"
.33" high
.32 low
.33

.32
.34

9.3 11.6 6.6
10 10.3 8

Rt fan
106 low
106.2 "
106.21
106.33
106.21
.12"
106.27
120.30"
106.270
9.5 to 14.03" 14.035
9.5 14.03 120.3030 8.5"
1.2.24
8.065

Cube = 4th pour

~~120~~ 120.2 & little 120.36 left in
120.2 +.1 & much 4th 120.23 pour
+.05 " " 3/ 20 0.61
+.02 " little 120.305 more
+.03

11.2 / evenings

9.5

11.=

2.6 11.

Metal —

Left pour 4th pour

20 Cobalt 12.3 Ground
10 Cobalt + 3 Cobalt 12.2 & little
+ 2 Cobalt 12.3 " "
+ 2 Cobalt
+ 1 " "
+.03 " little +.03
+.6 Cobalt +.06
12.4 & little
12.5 +.03 Cobalt +.05
+.02 " little
+.03 12.6
11.5 8.5
11.2
9.6 9.2 11.3
11.4
10 11.4
12.53 pour left pour 12.53
4th " 12.41
24.918
12.49

Balance — M.27

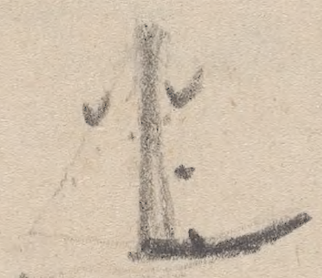
left	right.
B, 1⁻	16
4	15.3⁻
4.6	14.1⁻
5⁻	13.6
5.3	15.1⁻
5.3	13.
24.1⁻	11.7

4	15.3⁻
4.6	
4.6	14.1⁻
5.	13.6
5.38	
4) 18.28	3) 413.6
4.725	14.533
	4.725
	2) 19.1258
	9.6 = 3m.

Sample 5.

10 m. tube, bar

7	11.1
7.2	10.8
7.3	11.1
7.6	10.6



Wt. of cube in left-bar

100. b. tube
+ 30 b. rod
+ 20 " tube
+ 20 b. rod
+ 10 " "
+ 5⁻ " "
+ 2 " "
+ 1 " "

100.+20+.2+.1+.05⁻ b. rod
+.02 b. tube

left	rt
10.1	12
10.5⁻	11.9
10.7	11.9
11.	11.5⁻
	+.01
9.2	11.6
9.8	11.5⁻
10.2	11.4
10.5⁻	11.5

120.38 +